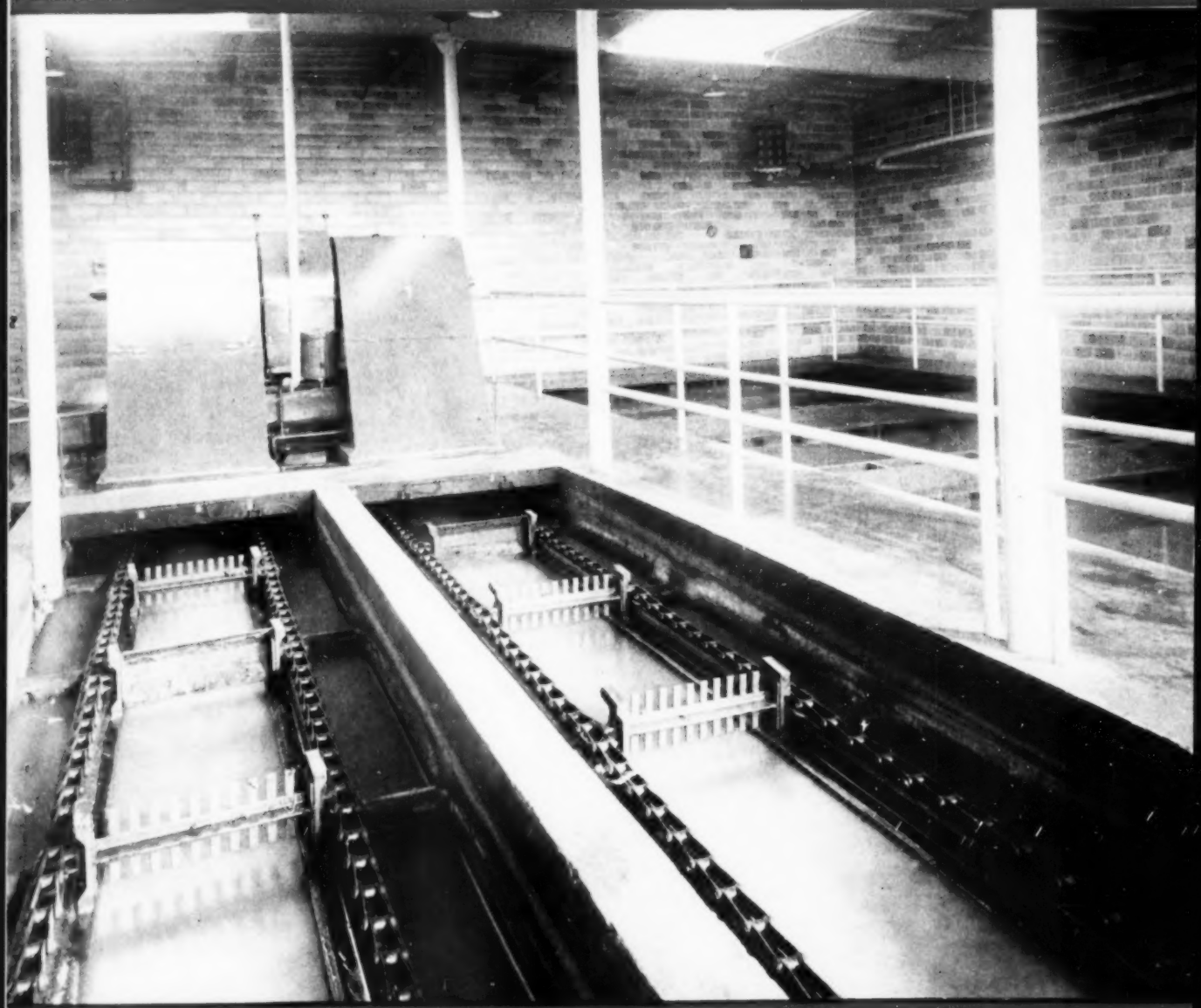
# WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL



AUGUST, 1953

Grit Chambers of Manitowoc . . . .

("GRIT CHAMBERS—their function, operation and control"—*Bloodgood.*)

# They all come back for more...

## from LOCK JOINT

*36" Lock Joint Reinforced Concrete Cylinder Pipe being installed for Norfolk, Va.*

*Laying 72" Lock Joint Reinforced Concrete Cylinder Pipe at Detroit, Mich.*

**YEAR AFTER YEAR** satisfied customers turn and return to Lock Joint to solve their pressure pipe problems. The customers listed on this page have reordered Lock Joint Pipe from twice to more than forty times for the continuing construction of major water works installations . . . a total of nearly 1,500 miles of Lock Joint Pipe delivered on *reorders alone*. The variety of Lock Joint's designs makes the pipe suitable for any water works project requiring pressure pipe 16" in diameter or larger. Its low first cost, negligible maintenance charges, permanent high carrying capacity and unfailing service cause more and more water works officials to agree that "You can't go wrong with Lock Joint."

*Laying 66" Lock Joint Reinforced Concrete Pressure Pipe for Tulsa, Okla.*

*Installation of 90" Lock Joint Reinforced Concrete Pressure Pipe for Denver, Colo.*

Alexandria, Va. • Altus, Okla. Ashtabula, Ohio • Baltimore, Md. Bethlehem, Pa. • Birmingham, Ala. Boston, Mass. • Caracas, Venezuela Charlotte, N. C. • Chattanooga, Tenn. • Chicago, Ill. • Cleveland, Ohio • Cumberland, Md. • Denver, Colo. • Detroit, Mich. • Dominican Republic • E. St. Louis, Ill. • Flint, Mich. • Ft. Collins, Colo. • Greeley, Colo. • Greensburg, Pa. Harrisburg, Pa. • Hartford, Conn. Houston, Tex. • Huntington, W. Va. Huntsville, Ala. • Hyattsville, Md. Johnstown, Pa. • Kansas City, Mo. Little Rock, Ark. • Louisville, Ky. Maracaibo, Venezuela • Mobile, Ala. • Newark, N. J. • Newport News, Va. • New York City, N. Y Norfolk, Va. • Paterson, N. J. Portland, Me. • Portsmouth, Va. Providence, R. I. • Pueblo, Colo. Richmond, Va. • Rochester, N. Y. Saginaw, Mich. • San Juan, Puerto Rico • Shreveport, La. • South Pittsburgh, Pa. • Syracuse, N. Y. Tennessee Valley Authority Toledo, Ohio • Trenton, N. J. Tulsa, Okla. • Washington, D. C. W. Palm Beach, Fla. • Wichita, Kan. • Wilmington, Del. Worcester, Mass.

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains 16" in diameter or larger, as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

**LOCK JOINT PIPE COMPANY**

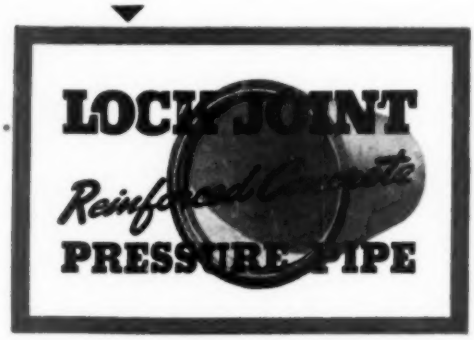
*Established 1905*

**P. O. Box 269, East Orange, N. J.**

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.

SEWER & CULVERT PIPE PLANTS:

Casper, Wyo. • Cheyenne, Wyo. • Denver, Col. • Kansas City, Mo. Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. Kenilworth, N. J. • Hartford, Conn. • Tucumcari, N. Mex. • Oklahoma City, Okla. • Tulsa, Okla. • Beloit, Wis. • Hato Rey, P. R. • Caracas, Venezuela



Tests Prove

# CLAY PIPE is detergent-proof!

Of course it is. Clay pipe is chemically inert. Detergents can't weaken it, soften it, or separate its particles. All they can do is keep it clean.

Comparative laboratory tests show that *other* types of sewer pipe may fail, however, in contact with detergents. One non-clay material failed after only 500 hours in a *one-percent solution* of a popular detergent at "dishwater temperature." A lab technician was able to pull it apart and shred it with his fingers.

Important? You bet it is! Hundreds of thousands of gallons of detergent solutions pour into a city's sewers every day. There's no *safe* substitute for Vitrified Clay Pipe. It's the *only* chemically inert pipe . . . the only pipe that can't wear out. It stays rock-hard . . . glass-smooth . . . die-straight, year after year in the ground. *And it's guaranteed for half a century!*

**NATIONAL CLAY PIPE MANUFACTURERS, INC.**
1520 18th St. N. W., Washington 6, D. C.
206 Connally Bldg., Atlanta 3, Ga.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
703 Ninth & Hill Bldg., Los Angeles 15, Calif.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio

*ESSENTIAL • ECONOMICAL • EVERLASTING*

*Vitrified*
CLAY
CLAY PIPE NEVER WEARS OUT!
PIPE

C-153-A

# HTH Tablet Hypochlorinator Quiz

**Q.** *Is HTH Tablet Hypochlorination expensive?*

**A.** Indeed not. The initial cost of the unit is extremely low, the operation is inexpensive, and little or no maintenance is required.

**Q.** *How about dependability?*

**A.** The HTH Tablet Hypochlorinator is designed simply yet sturdily with no moving parts. Install it and set the flowmeter . . . the Hypochlorinator will accurately treat water, sewage effluents or industrial wastes with a constant dosage of hypochlorite solutions.

**Q.** *What do the tablets consist of?*

**A.** They're exactly the same material as the HTH you've been using safely for chlorination all these years. We've pressed Sanitation HTH into tablets for use in the Tablet Hypochlorinator to give you a most convenient method of hypochlorination. They contain 70% available chlorine.

**Q.** *How does it work?*

**A.** After installation, you fill the Tablet Hypochlorinator with HTH Tablets and set the flowmeter to get the chlorine dosage you need. The flowmeter then injects the feed water into the lower portion of a bed of HTH Tablets . . . this dissolves the tablets slowly and provides a continuous discharge of fresh hypochlorite solution. The flowmeter can be adjusted to cover a wide range of dosage to assure adequate treatment.

**Q.** *Where can I get more information on HTH Tablets and the HTH Tablet Hypochlorinator?*

**A.** Your HTH supply house can give you all the information you'll need. Or you can use the handy coupon below; you'll have the information promptly.

1016-B

**MATHIESON CHEMICAL CORPORATION**
**Mathieson Industrial Chemicals Division**
**Baltimore 3, Maryland**

MATHIESON

**MATHIESON CHEMICAL CORPORATION**
**Mathieson Industrial Chemicals Division**
**Baltimore 3, Maryland**

**Please send me full information on the HTH Tablet Hypochlorinator.**

**NAME** _____

**ADDRESS** _____

**CITY** _____ **STATE** _____

WATER AND SEWAGE WORKS. Reg. U. S. Patent Off. Published monthly by Scranton Publishing Co., at 404 North Wesley Ave., Mount Morris, Ill. Entered as second class matter Mar. 4, 1948, at the post office at Mount Morris, Ill., under Act of March 3, 1879. For subscription rates, see Contents Page.

# WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT


COMING ARTICLES

America's First Stationary Bulk-Storage of Liquid Chlorine.....*Benas*
How Aqueduct Chlorination Helped Avert a Water Shortage.....*Streicher*
Guides for the Selection of Chemical Feeders.....*Coffman*
Improved Practices Needed in Stream Pollution Control.....*Watson*
The Selection, Operation and Maintenance of Valves.....*Kauffman*
Fundamental Principles of Chlorine Handling (Part 3).....*Langworthy*
Waves as a Factor in Off-shore Disposal of Sewage.....*Rice & Johnson*
Metering at Chicago's West—S.W. Sewage Treatment Plant.....*Anderson*
Increasing Well Yields With Calgon Treatment.....*Caplan*
Water Works Practices (short course type articles*).....*Symons*

* In this issue is one of the same type of articles on *Sewage Works Practices* by Professor Don E. Bloodgood. Articles of the Symons and Bloodgood series are currently running in alternate issues.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VOL. 100 **August, 1953** No. 8



**The Case for Sludge as a Soil Improver** ..... 295
by Herbert A. Lunt, *New Haven, Conn.*

**1953 Conference of A.W.W.A. in Grand Rapids, Mich.** ..... 302

**Stationary Bulk Storage of Liquid Chlorine** ..... 310
by A. S. Woodward, *of Philadelphia, Pa.*,
and L. L. Hedgepeth, *Bound Brook, N.J.*

**Demand Charge Approved for Water Service in Air-Cooling** ..... 314
by J. R. Pierce, *Pine Bluff, Ark.*

**Meeting of Maryland-Delaware Water and Sewage Assn.** ..... 315

**Fundamental Principles of Handling Chlorine** (Part II) ..... 318
by V. W. Langworthy, *New York, N.Y.*

**Report from Abroad** ..... 323
by John Finch, *Rotherham, England*

**Sewage Works Practices** ..... 326
No. 4—Grit Chambers—Their Function, Operation, and Control
by Don E. Bloodgood, *of Lafayette, Ind.*

**Safety in Sewage Works Maintenance and Operation** (Part II) ..... 330
by LeRoy W. Van Kleeck, *Hartford, Conn.*

**A Special Statement by The Publisher** ..... 332

Meetings Scheduled ..... 74A

Manufacturers' and Equipment Items ..... 86A

Literature and Catalogs ..... 108A



Published Monthly—subscriptions in the U.S., Canada and Latin America $2.00 per year; Foreign $3.00. Single copies 25c
**(Member—Audit Bureau of Circulation and Associated Business Publications, Inc.)**

A quick switch and here's the Hydrocrane — setting water pipe. Telescoping boom permits reaching for extra footage — without moving crane an inch!

Here the Hydrohoe digs a pipe trench. By telescoping boom operator can peel off scallops at grade level — dig a smooth, even trench.

# Quick Boom Switch

## GIVES YOU A MONEY-SAVING CRANE-HOE TEAM

Owners report that Hydrocrane and Hydrohoe booms can be switched in less than an hour. This exceptional convertibility can save time — mean additional savings for you. For example you can dig trenches or valve pits in the morning — convert to crane front end — and set pipe, valves or hydrants in the afternoon.

With this quick, simple convertibility the two front ends can work as a team right on the same job.

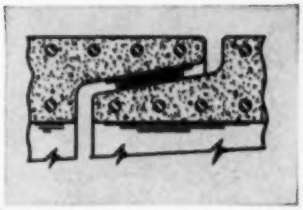
In addition to this top speed convertibility, the all-hydraulic Hydrocrane offers you:

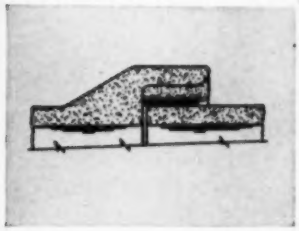
- **50 mph travel speed**
- **Quick-set hydraulic outriggers**
- **Simple, hand lever control — no foot brakes**
- **Telescoping boom**
- **Safety and exact precision of hydraulic operation**

See your distributor for a demonstration. We'll be glad to send you his name. 43H53

**BUCYRUS ERIE** SOUTH MILWAUKEE, WISCONSIN

TYPE "A" GASKET
For Tongue-and-Groove Pipe





TYPE "B" GASKET
For Bell-and-Spigot Pipe

# T LEAK *IN* OR *OUT* OF

# TYLOX

*flexible rubber*

# SEWER PIPE JOINTS

When you write "TYLOX RUBBER JOINTS" into the specifications of your tongue-and-groove, or bell-and-spigot sewerage and drainage projects, you protect the lines, now, and in the *future*, against costly infiltration and root penetration.

*Flexible* rubber Tylox Gaskets seal by compression, not adhesion. Tylox "packs" the joint's annular space tight by mechanical action, as the pipe is shoved home. Unlike bituminous or mortar jointing materials, there's no shrinking or crumbling as the years go by . . . the natural resilience of rubber Tylox *keeps* the joint tight, permanently eliminating the "leaky" joints that bring on root troubles and permit infiltration that increases operating costs at treatment plants.

Protect the joints of *your* sewerage and drainage projects — and assure their faster construction — by writing "TYLOX RUBBER JOINTS" into your next pipe specification. Tylox won't corrode or deteriorate. Under ground, and under compression, Tylox Joints outlast the life of the pipe itself.

## MAKING JOINTS WITH TYLOX RUBBER GASKETS IS AS SIMPLE AS A B C

Cement tongue and snap on TYLOX gasket

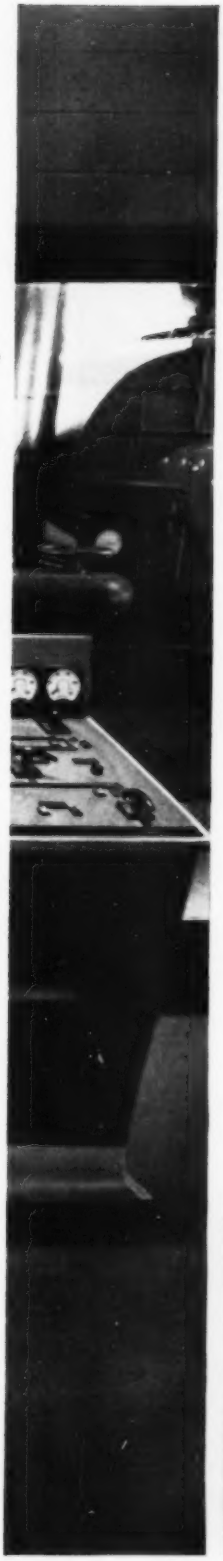
Lubricate sliding surfaces with TYLOX cement

Shove the pipe home to line and grade.

1819

**HAMILTON KENT**
**MANUFACTURING COMPANY**
KENT, OHIO

***New Hunts Point Sewage Control Plant,*** Bronx, New York, has a design capacity of 120 million gallons per day (mgd). Future plant expansion will ultimately increase capacity to 150 mgd. J. Livingston & Co., New York City, electrical contractor.



# Sound planning and unit equipment assure reliable power at Hunts Point

Service continuity is extremely important to the new 120-mgd Hunts Point Sewage Disposal Works—significant step in the City of New York's pollution control program. Shutdowns would affect a tributary population of 770,000 in a 15,613 acre area.

Based on a careful study during the blueprint stages, engineers for the Department of Public Works, City of New York, designed a duplex electrical distribution system. It assures reliable service by providing dual feeders, switching capacity and transformers, plus electrical tie breakers.

Supplementary power is available from two by-product gas engine generators—each rated 875 kva. These can also be operated as blower drive motors.

Westinghouse power, switching and control equipment play a vital part in the duplex system. Co-ordinated specifically for Hunts Point, this completely unitized line installed easily. It simplifies maintenance due to accessibility of breakers and controls. It assures easy, economical expansion because of its inherent flexibility.

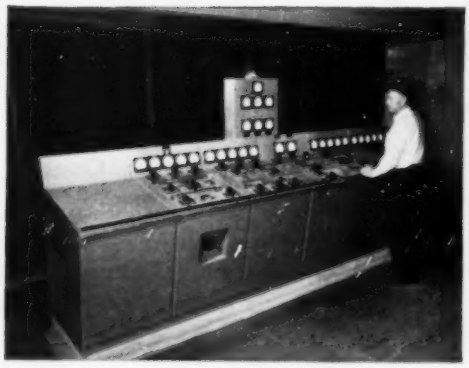
Hunts Point is another instance of Westinghouse participation in sewage control projects—ranging from special engineering assistance to supplying a complete line of electrical distribution equipment.

Call your nearest Westinghouse office for examples in your own area. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

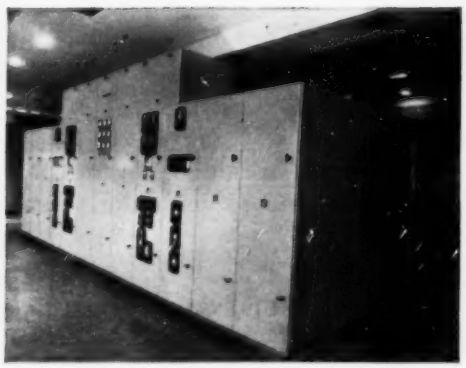
J-94962

YOU CAN BE SURE...IF IT'S

Westinghouse



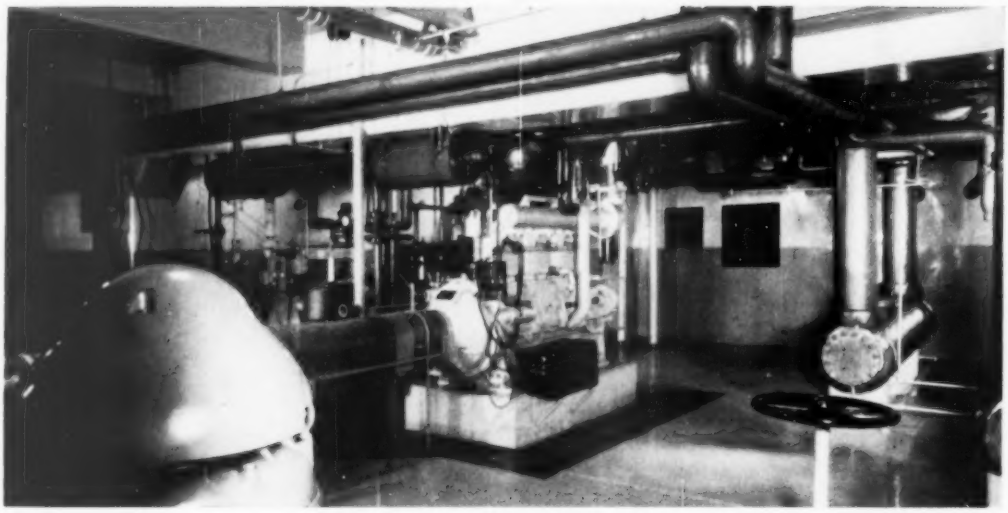
***Westinghouse Main Control Benchboard*** provides finger-tip control of virtually all plant operations. From it, utility and plant power can be controlled through remote switching of feeders and transformers in both systems.



***Westinghouse Indoor Metal-Clad Switchgear,*** 4160 volts, is located back to back with similar switchgear which controls utility power supply. Factory assembled and tested, this compact unit installed easily and saved building space.

# HERESITE

REG. U. S. PAT. OFF.



The above view shows an Engine Room completely coated with the HERESITE VR-500 Series Air Drying Coatings. After 5 years the coated surfaces are still in good condition.

Reports from the same plant show that HERESITE VR-500 Series Air Drying Coatings have been applied to the cast concrete ceiling in the Clarifier Room and after 9 years of service no recoating is necessary. Also, successfully coated are the Detritor Room, Pump Room and all Pipe Galleries.

HERESITE VR-500 Series Air Drying Coatings offer complete resistance to moisture, mild acids and alkalis. No special equipment is necessary for application.

HERESITE AR-900 Series chlorinated rubber Air Drying Coatings are especially suited for chlorine and hypochlorite exposure.

HERESITE AD-600 Series Coatings possess excellent resistance to caustic alkalis requiring only evaporation of the solvent to form a tough tenacious film.

HERESITE & CHEMICAL COMPANY—Manitowoc, Wisconsin

*Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.*

**THIS ILLUSTRATION** showing the installation of U.S. mechanical joint pipe in a residential area is a typical scene. It could be either a water, gas or sewer line installed to furnish reliable utility service for present and future generations in the community.

U.S. cast iron pipe centrifugally cast in metal molds is a quality product produced by a modern casting process which is carefully controlled from raw material to the finished pipe.

We are well equipped to furnish your requirements for cast iron pipe and fittings made in accordance with American Standard, American Water Works Association and Federal specifications. U.S. pipe centrifugally cast in metal molds is available in sizes 2- to 24-inch and pit cast pipe in the larger sizes.

**United States Pipe and Foundry Co.,**
**General Office, 3300 First Ave., N. • Birmingham 2, Ala.**
**Plants and Sales Offices Throughout the U.S.A.**

**U.S.**
**cast iron**
**PIPE**
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

Our General Office is now located in Birmingham, Ala., instead of Burlington, N. J.

# HORTON STANDPIPE

FOR

## NEW

WATER SYSTEM
AT HOOKSETT

The 200,000-gallon Horton* standpipe shown above was selected for a vital role in the new water system operated by the Hooksett, N. H., Water Precinct. This welded steel structure is vitally important because it provides the only storage in the distribution system.

The water supply for Hooksett is taken from nearby Pinnochle Pond, treated with chlorine and pumped directly into the distribution system. The standpipe is filled when water usage is low. The reserve of water built up in it flows back into the distribution system during peak load periods. Consulting Engineers for the Hooksett water system were Whitman and Howard of Boston, Mass.

Horton standpipes and reservoirs are available in sizes up to 10,000,000 gallons. Horton elevated water tanks for municipal water service are built with ellipsoidal-bottoms in standard capacities from 15,000 to 500,000 gallons. Elevated tanks with radial-cone bottoms are built in standard sizes from 500,000 to 3,000,000 gallons. For estimates or quotations please write our nearest office. State capacity desired, location and height to bottom. There is no obligation.

**Trade Mark Registered in U. S. Patent Office*

**HORTON**

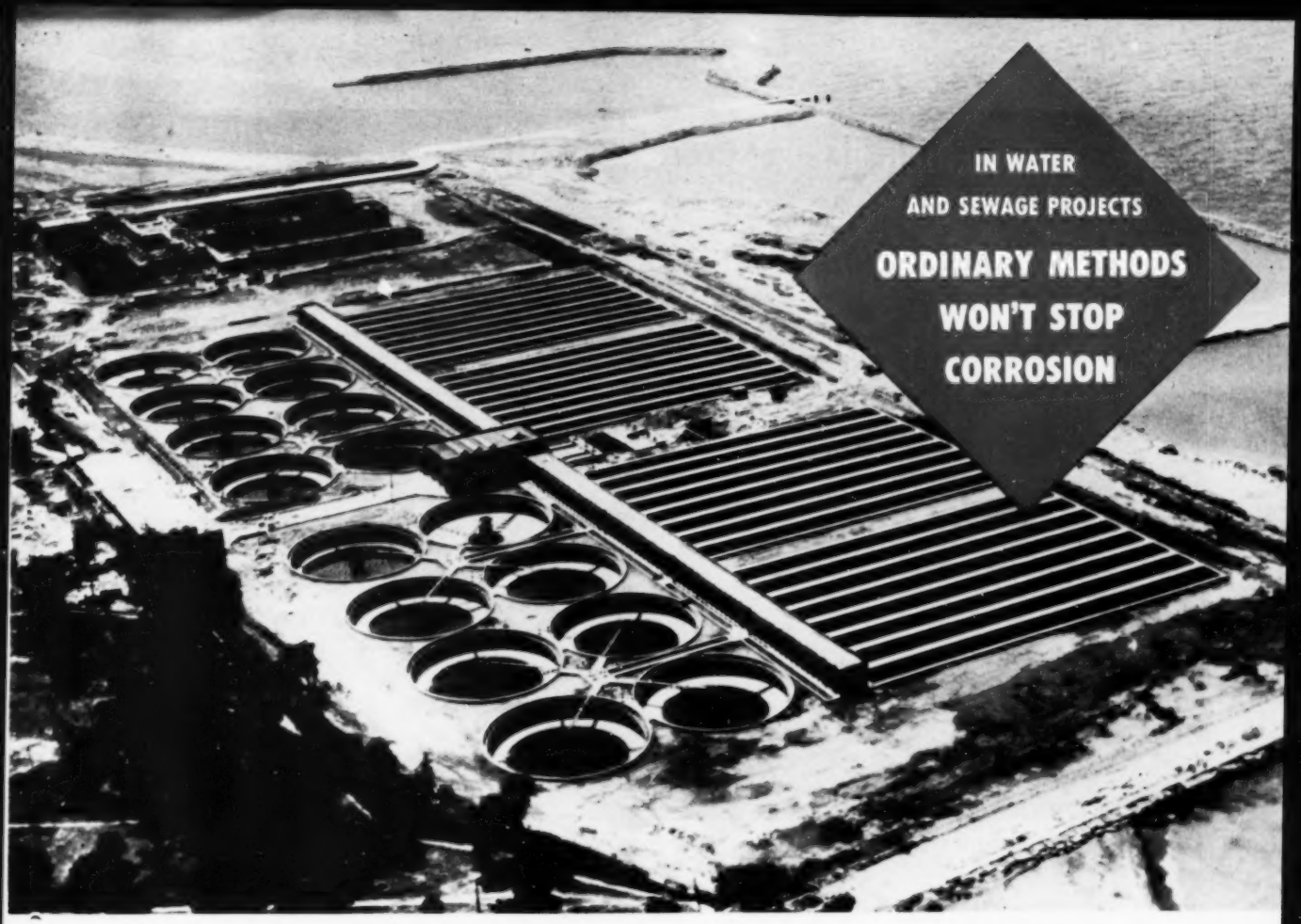
WELDED STEEL

STORAGE TANKS

**CHICAGO BRIDGE & IRON COMPANY**

**Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.**

| | | | |
|---|---|---|---|
| Atlanta 3 | 2181 Healey Bldg. | Los Angeles 17 | 1555 General Petroleum Bldg. |
| Birmingham 1 | 1586 North Fiftieth St. | New York 6 | 3390—165 Broadway Bldg. |
| Boston 10 | 1048—201 Devonshire St. | Philadelphia 3 | 1644—1700 Walnut Street Bldg. |
| Chicago 4 | 2198 McCormick Bldg. | Pittsburgh 19 | 3260 Alcoa Bldg. |
| Cleveland 15 | 2262 Midland Bldg. | San Francisco 4 | 1583—200 Bush St. |
| Detroit 26 | 1551 Lafayette Bldg. | Seattle 1 | 1530 Henry Bldg. |
| Houston 2 | 2115 C. & I. Life Bldg. | Tulsa 3 | 1646 Hunt Bldg. |




# SPECIFY THE AMERCOAT METHOD— Designed to Give You *PLUS* PROTECTION

Ordinary methods for controlling corrosion usually produce the ordinary results—rapid paint failure, costly replacements, product contamination, excess down-time, and hampered production. Halfway measures and the use of one or two general purpose coatings simply cannot provide adequate protection against corrosion's ceaseless attack.

Amercoat gives you a proven method of corrosion control, assuring you proper protection through these PLUS features:

**1. Careful analysis** by a trained engineer of all the conditions present in each corrosion problem.

**2. The ONE best recommendation** for the particular problem. AMERCOAT is a complete line of coatings, each formulated to solve or control specific corrosion problems.

**3. On-the-job assistance** to your applicators and supervisors by a trained engineer. The AMERCOAT method ensures proper attention to surface preparation and application techniques for maximum protection.

**4. Complete stocks** of fresh materials always near you at one of AMERCOAT's five regional warehouses or more than 20 franchised distributor warehouses throughout the United States.

**5. Service based on experience.** The AMERCOAT method of corrosion control is the result of nearly 20 years' experience in solving or controlling corrosion problems in every major industry throughout the United States.

Write today for the name and address of the AMERCOAT representative in your area. At no obligation, he will gladly help you analyze your corrosion problems and evaluate your present control measures. If it is determined that you have a problem within our scope of experience, he will outline a complete program of AMERCOAT's PLUS protection for your plant or equipment.

Amercoat CORPORATION

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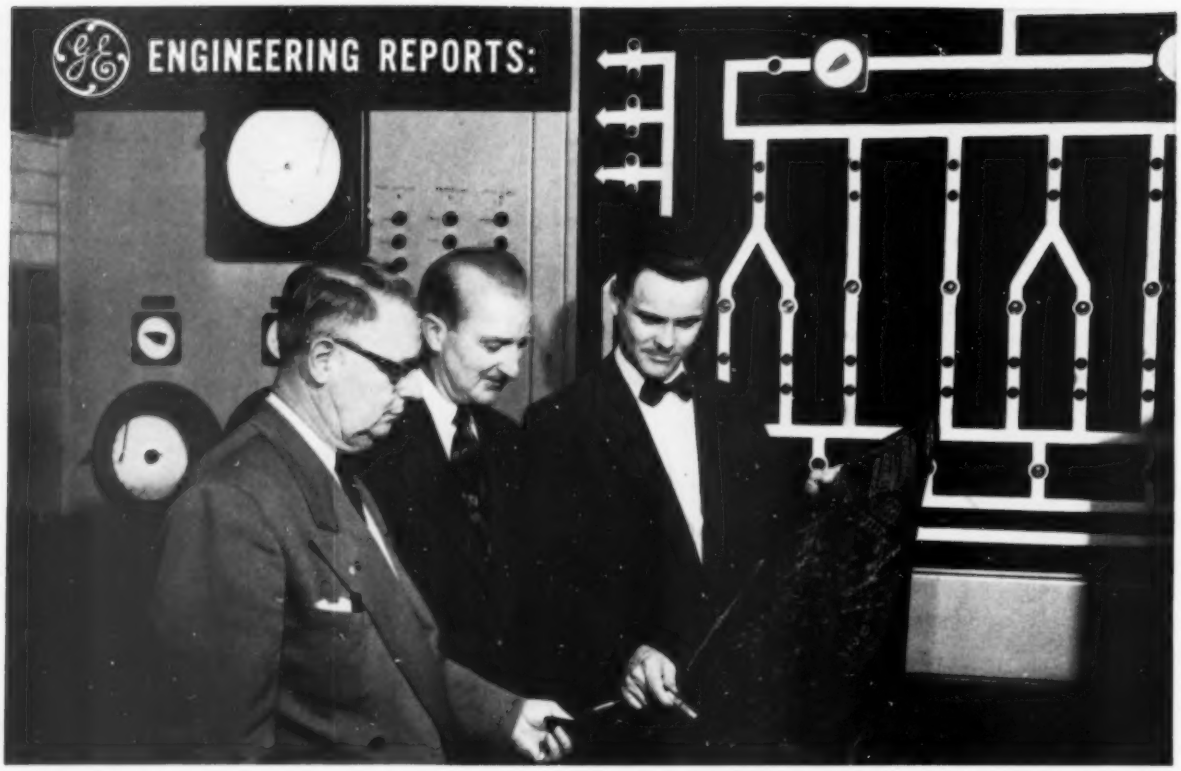
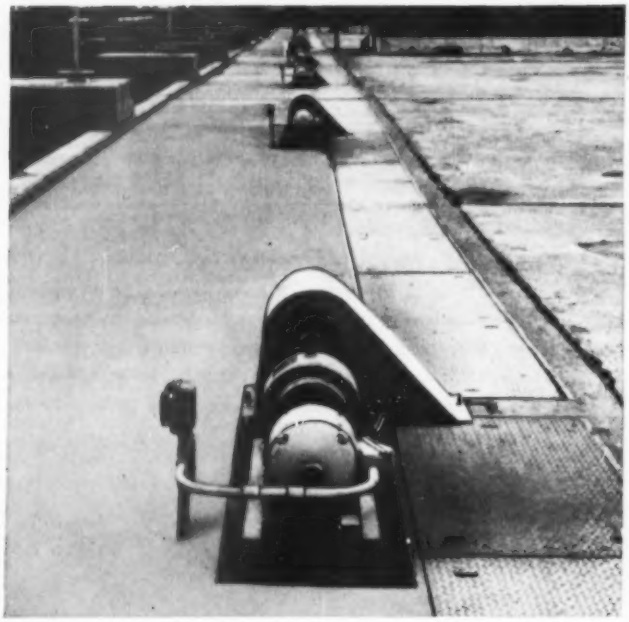
Chicago, Ill.
Newark, N. J.
Jacksonville, Fla.
Houston, Texas

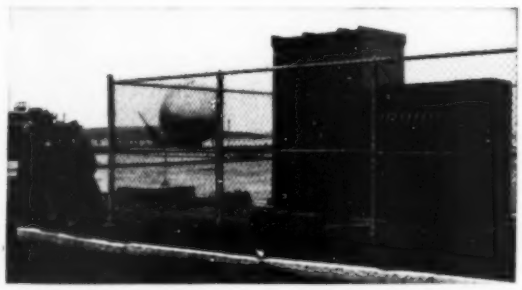



**G-E APPLICATION ENGINEER** A. L. Hammett is shown examining diagram of sludge-digester tank with Wm. McRoberts, senior electrical engineer of Boston's MDC Construction Division and H. R. Acres, G-E Sales Engineer (r. to l.). According to Mr. McRoberts, "We are favorably impressed with the operation and the low maintenance requirements of the General Electric equipment." In background is G-E flow diagram panel of unique plant system.

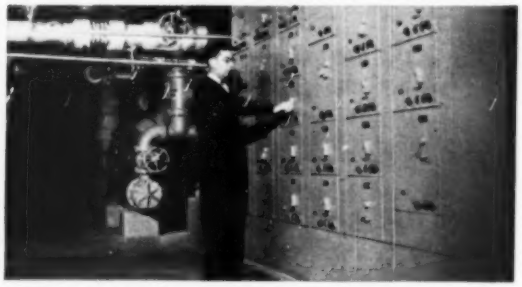
# Boston takes major step in



**12 SLUDGE COLLECTORS,** driven by G-E Tri-Clad TENV motors, pull sludge from six underground tanks into trough, from which it is transported to digester tanks where gas is extracted.

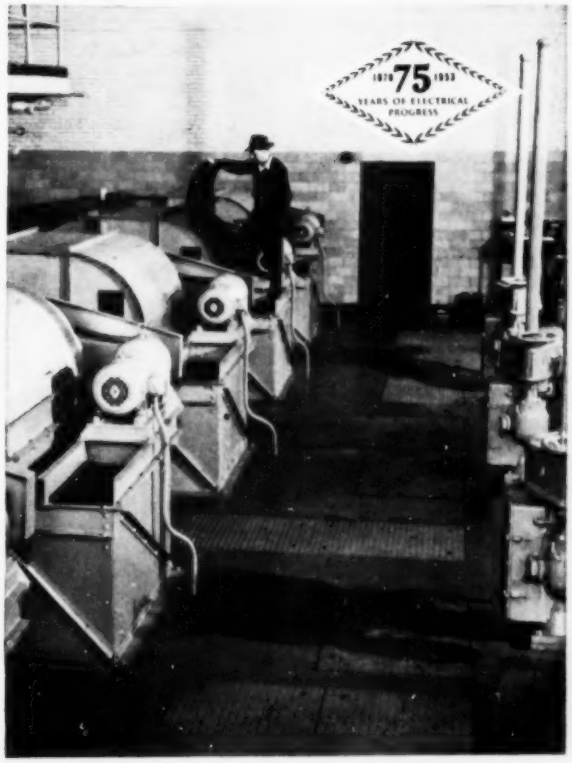


**UNIT SUBSTATION** steps down power from 2400 to 480 volts for the outdoor collector drives and sludge pumps.



**MAIN MOTOR CONTROL CENTER,** one of five in plant, controls 26 pumps, compressors, and purifiers. This G-E 480-v panel is located in basement of main building.

**2400-V POWER** is distributed from this G-E switchgear—heart of the electrical system—to four main pumps controlled by limitamp panel. Nut Island's senior civil engineer, A. J. Griffin, is shown taking readings from switchgear panel.




**SYSTEM BEGINS** in grit room where raw sewage flow is controlled by six gates (three shown at right) and passed through six grit collectors (four shown at left). Both gates and grit collectors are powered by G-E Tri-Clad* induction motors.

# plan for CLEAN WATERS

## New Nut Island treatment plant is first half of plan to make harbor recreation areas safe

When Boston's new Nut Island sewage treatment plant at Quincy goes into full-scale operation this year, it will have a maximum capacity of 300-mgd and will be the first half of a long range plan to make Boston Harbor waters safe again for bathing and recreation. In the near future, another plant will be built at Deer Island which will eliminate pollution in the entire harbor.

The Metropolitan District Commission—Construction Division (F. W. Gow, Chief Engineer) of Boston, designer of the plant, Anderson-Coffey Co., Inc., electrical contractor, and Thomas O'Connor, general contractor, were aided in pre-construction electrical planning by G-E application engineers, who helped design the entire electrical system, specify standard equipment, and supervise installation.

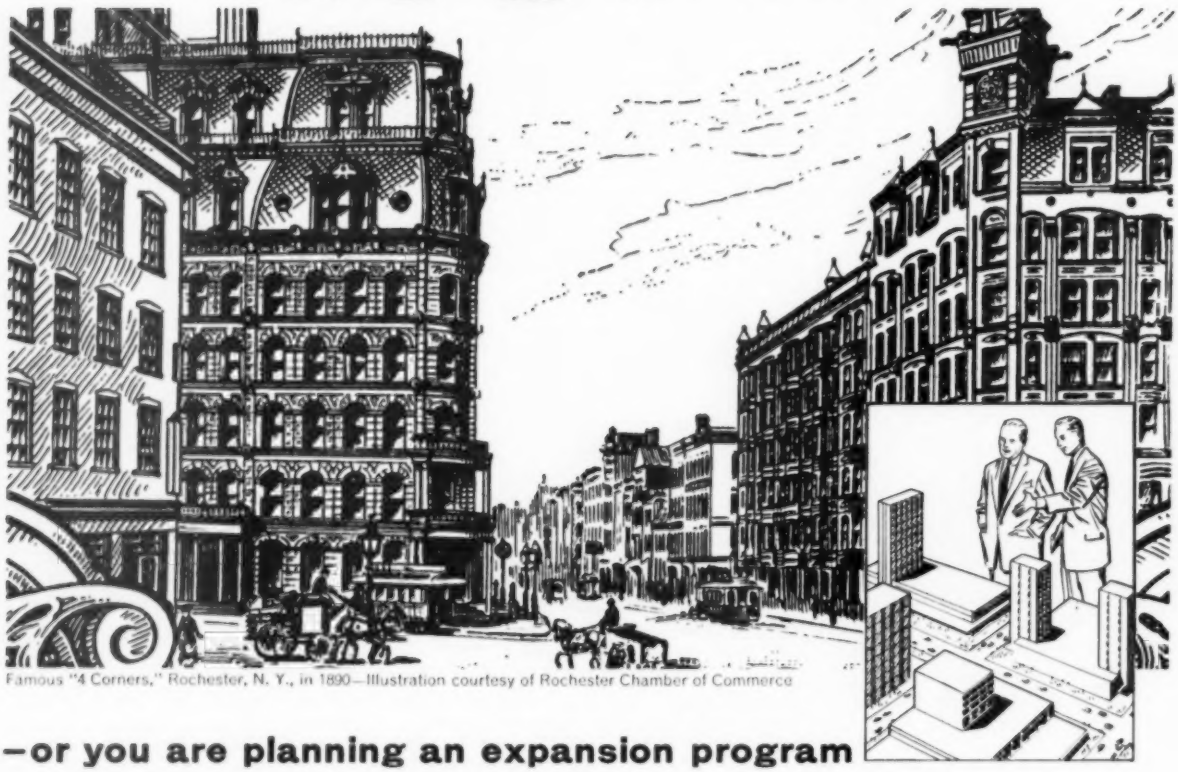
Specialists in sewage-plant electrification, G-E application engineers are ready to work with *your* engineers and consultants. Backed by unexcelled engineering facilities, they'll help in designing a coordinated electrical system for your new plant or modernization project. Contact your local G-E Apparatus Sales Representative early in the planning stage. Ask him how you can put G.E.'s CLEAN WATERS program to work in your community. General Electric Company, Schenectady 5, N. Y. 666-78

*Reg. Trade-mark of General Electric Company

**Engineered Electrical Systems for Sewage Plants**

**GENERAL ELECTRIC**

# Whether your city's water works system is 100 years old . . .



Famous "4 Corners," Rochester, N. Y., in 1890—Illustration courtesy of Rochester Chamber of Commerce

## —or you are planning an expansion program

# EDDY Mechanical Joint Hydrants

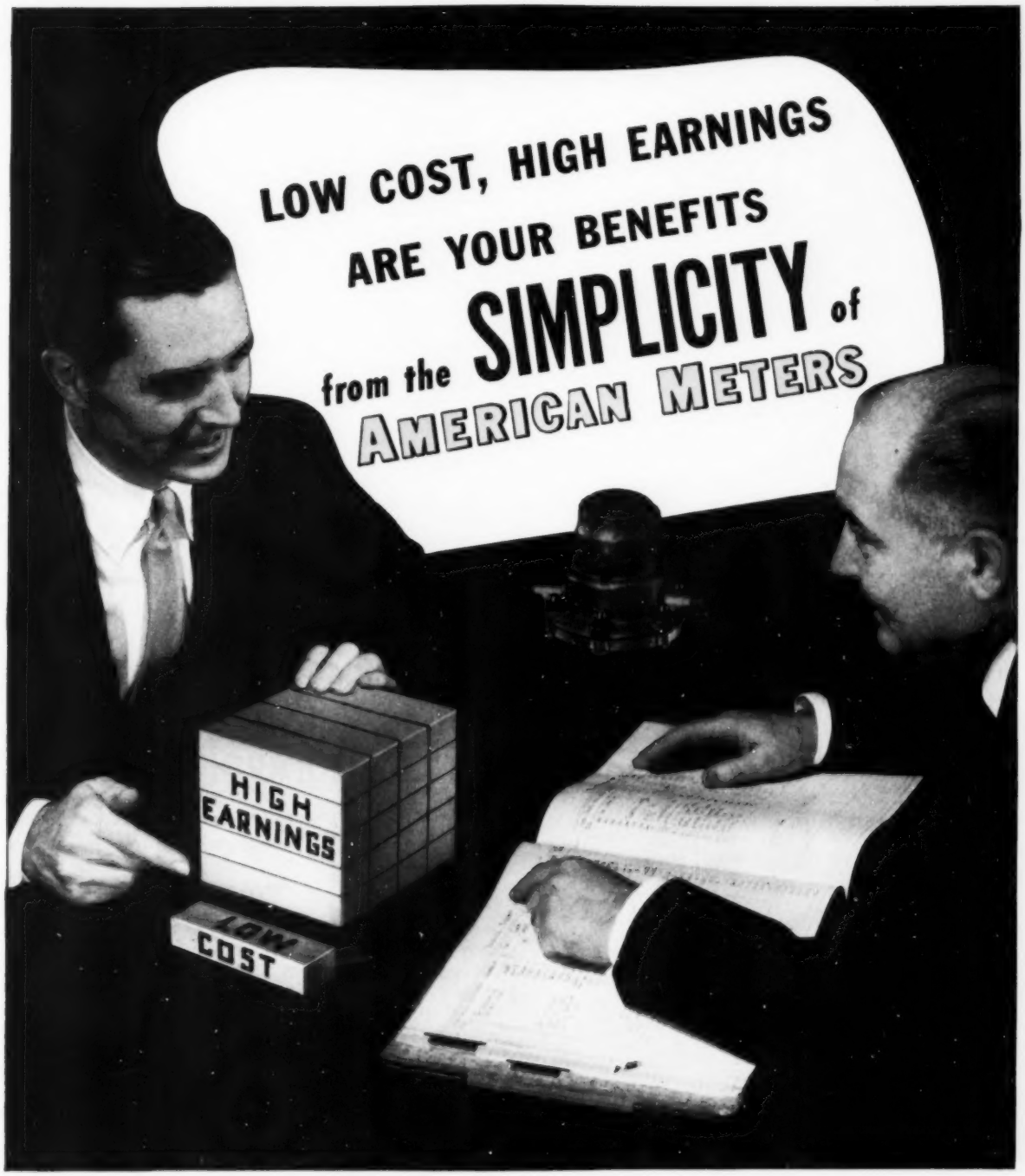
### will fit any pipe in your water distribution system

No matter how old your present system is—no matter where, how or when made—Eddy Hydrants are ideally suited for emergency replacement or expansion of your existing facilities. They can be quickly installed in any kind of weather or in a flooded trench. A ratchet wrench is the only tool needed! One man can remove all operating mechanism for inspection or repair.

And no matter how far into the future your city planning is projected, Eddy Hydrants are your best long term investment. Large waterways insure a plentiful flow of water. Hydrant opens smoothly with the pressure and closes without water hammer. Stem held in place below main valve means no water loss due to a bent stem. When in closed position, the hydrant barrel is automatically drained by positive drip action to prevent freezing. Eddy Hydrants are bronze mounted throughout.

**Mechanical joint connection cuts installation time—Available with or without the auxiliary valve . . .**

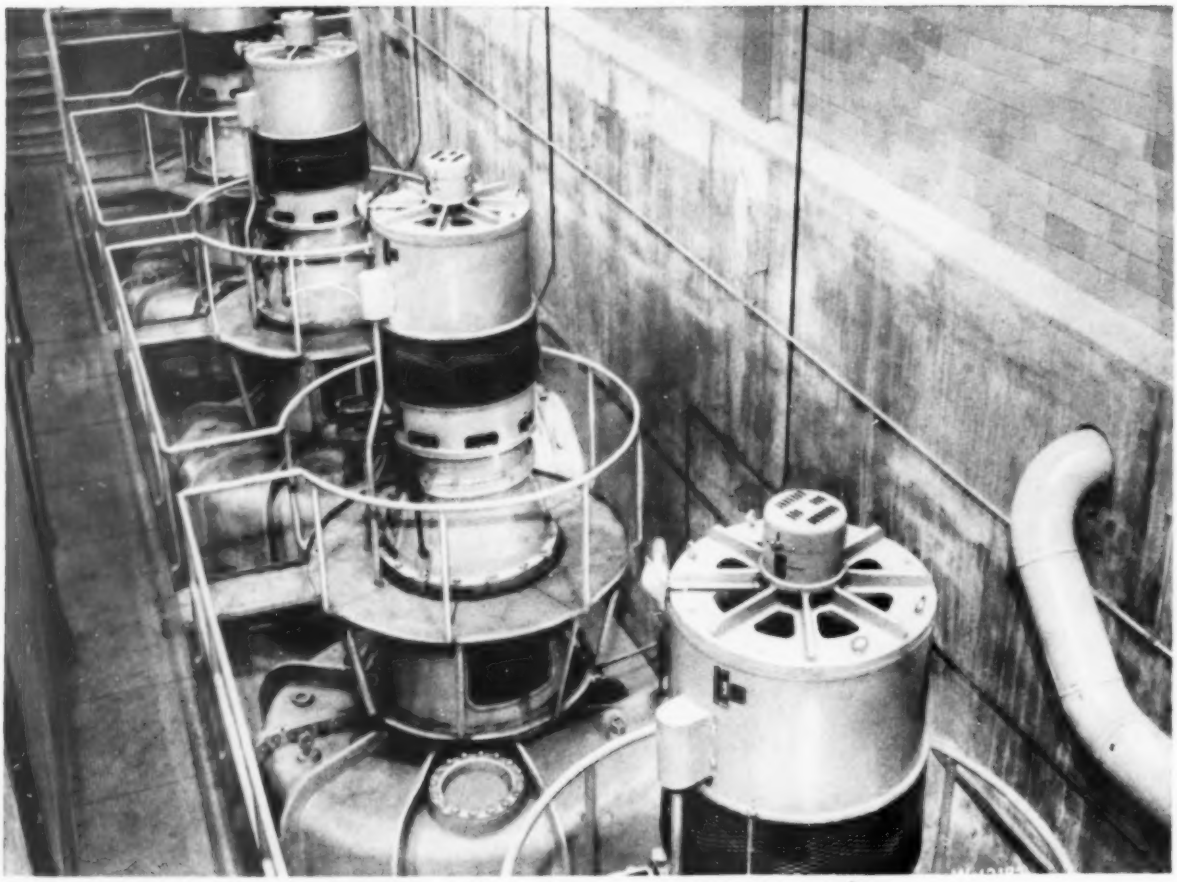
**EDDY VALVE COMPANY**
A Subsidiary of James B. Clow & Sons
**WATERFORD, NEW YORK**



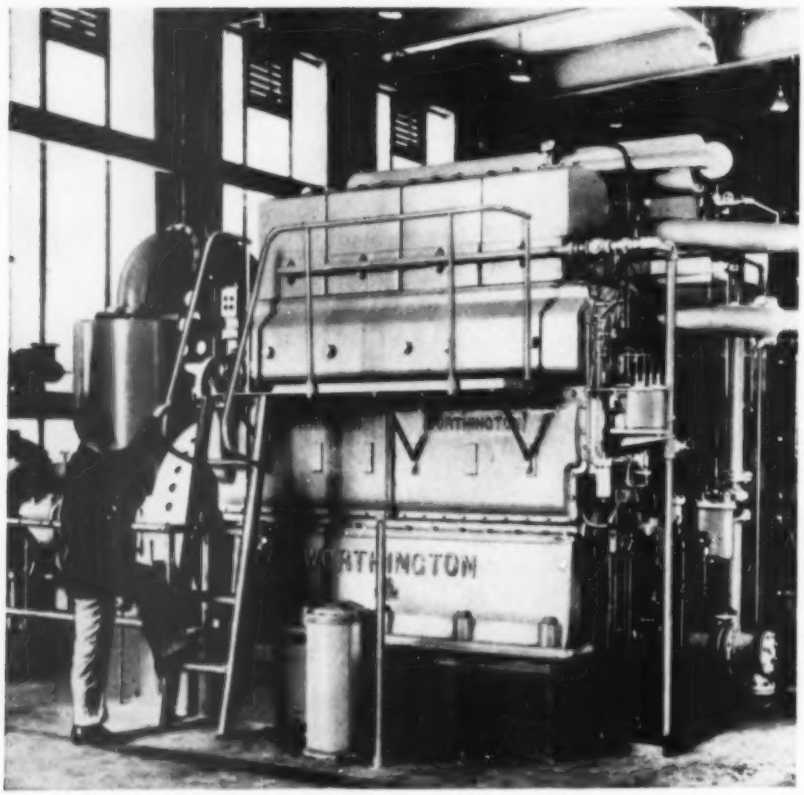

• American Meters are accurate and operate for decades without attention. They earn full revenue for you at low first cost and lowest maintenance cost. This is due to the simplicity of design—fewer parts—simpler castings—reduced opportunity for failure. American Meters have become a standard in hundreds of communities — cities and villages — and are giving full value.

# BUFFALO METER CO.

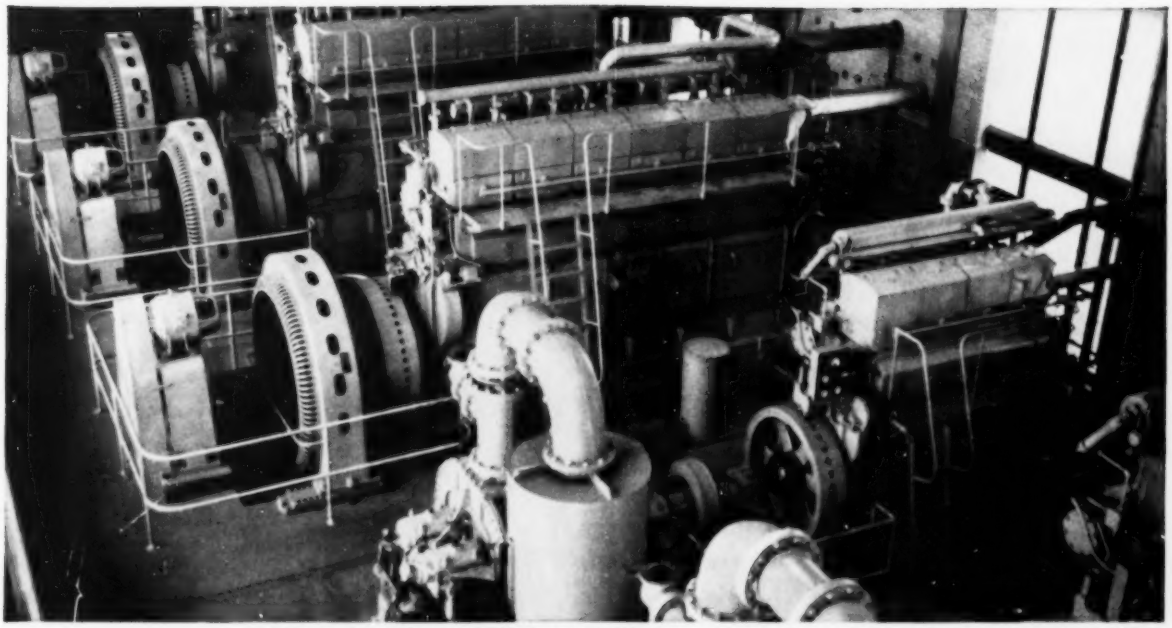
**2909 MAIN STREET, BUFFALO 14, NEW YORK**



**FOUR OF THESE WORTHINGTON MIXFLO PUMPS,** each with a capacity of 83 million gallons per day, move sewage through various stages of its treatment at Boston's Nut Island Plant. The pumps are designed to operate at variable speeds through the use of the magnetic drive which in connection with Worthington float control will maintain a pump-well level of not more than 3 inches above or below normal—even though pumping rates vary between 35 and 300 mgd.




**PRESENTLY USING SEWAGE GAS AS FUEL,** these Worthington dual fuel engines are designed to operate on either gas or oil. They will maintain load in the event of a sudden emergency loss of gas supply by automatically switching to oil. Two of these 215-hp units drive the sewage aeration blowers at Boston's new sewage treatment plant at Nut Island.



**DUAL FUEL ENGINES AUTOMATICALLY MAINTAIN LOAD** in the event of a sudden emergency loss of gas supply. These two 820-hp dual fuel engines and one 830-hp spark ignition gas engine drive three Electric Machinery generators. Two 215-hp dual fuel engines in the foreground drive positive displacement blowers.

# Worthington equipment at Nut Island Plant helps Boston reclaim Quincy Bay beaches

## Mixflo pumps have maximum capacity of more than 300 mgd of sewage

The new $10,000,000 Nut Island Plant at Quincy, Mass., is now treating 95 mgd of raw sewage which was previously pumped directly into Quincy Bay.

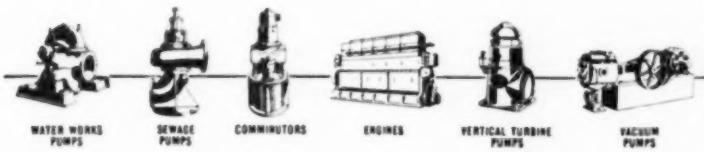
Four large Worthington Mixflo pumps, with Electric Machinery motor and magnetic drive, each with a capacity of 83 mgd, give this modern sewage treatment plant a reserve potential to meet any future demands.

Three large Worthington dual fuel engines drive the Electric Machinery generators which power the entire plant. Two smaller Worthington dual fuel engines drive the blowers for aeration of the sewage.

In addition to its larger pumps and engines shown here, Worthington also supplies comminutors, smaller sewage pumps, sludge removal pumps, and vertical turbine pumps for the water and sewage field.

Write us for a list of Worthington installations in your area, and complete information on how Worthington equipment can solve your sewerage problem. Worthington Corporation, Public Works Division, Section W.3.1, Harrison, N. J.

W-3.1




**All Major Public Works Equipment Under One Responsibility**

**WORTHINGTON**

Public Works Equipment

# Why research never says: "let well enough alone"

Anyone might fairly assume that cast iron pipe which has served, and is still serving, over 45 American cities for more than a century, is as efficient and economical as pressure pipe can possibly be. Our member Companies have not been content to rest on that assumption.

By continuous research and development, they have attained, in *modernized* cast iron pipe, greater toughness, strength and uniformity to a point resulting in still greater efficiency and economy.

*Modernized* cast iron pipe is centrifugally-cast. Where needed and specified, it is lined with cement mortar centrifugally applied, resulting in a tuberculation-proof pipe with sustained carrying capacity and, therefore, reduced friction loss and pumping costs.

If you want the most efficient and economical pipe ever made for water distribution, your new mains will be laid with *modernized* cast iron pipe with either mechanical or bell-and-spigot joints. Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

CAST Q IRON

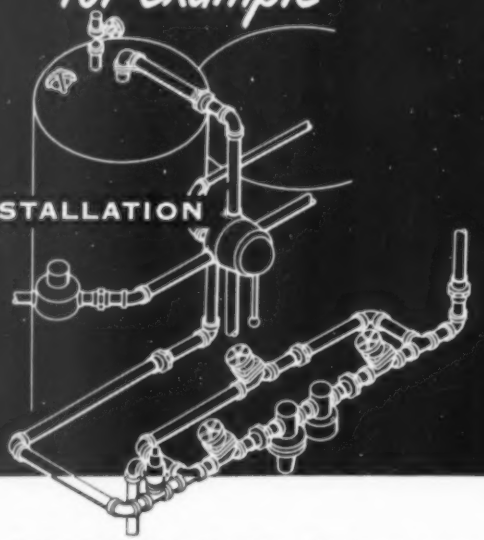
The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

*Modernized* **cast iron**

This cast iron water main, uncovered for inspection, is in good condition after 100 years of service in Alexandria, Va.—one of more than 45 cities with century-old water or gas mains in service.

# pipe *for Modern Waterworks Operation*

# This Valve Stops the "Up" in Upkeep ...on Water Service Piping, for example




At the Excello Paper Products Co., Inc., Cincinnati, using Crane Diaphragm valves on city water supply lines; also on plant service water piping, hot and cold.

## VALVE SERVICE RATINGS

**SUITABILITY:**
Doing what other valves couldn't

**FEATURES:**
Packless - Long Life Diaphragm

**MAINTENANCE COST:**
No regular maintenance needed

**SERVICE LIFE:**
Outlasting other valves many times

**OPERATING RESULTS:**
Safety hazard to personnel stopped

**AVAILABILITY:**
Crane catalog item - No. 1610

## THE CASE HISTORY

Typical of many processes using a lot of water, this plant has numerous open end lines and hose connections. And because of very frequent operation, the valves formerly used in these lines required more than usual servicing to keep up with leakage, dripping hose lines, and hazardous, messy floors.

Crane No. 1610 Diaphragm valves were selected to replace the troublesome conventional valves. Immediately these packless valves stopped the annoyance and expense of stuffing box and seat leakage. Their pliable disc insert ring made a tight seat on open end lines with minimum effort on handwheels.

The replacements were started about 2 years ago. With no attention whatsoever, all Crane Diaphragm valves remain tight, and the plant's water leakage problem remains solved.

## THE VALVE

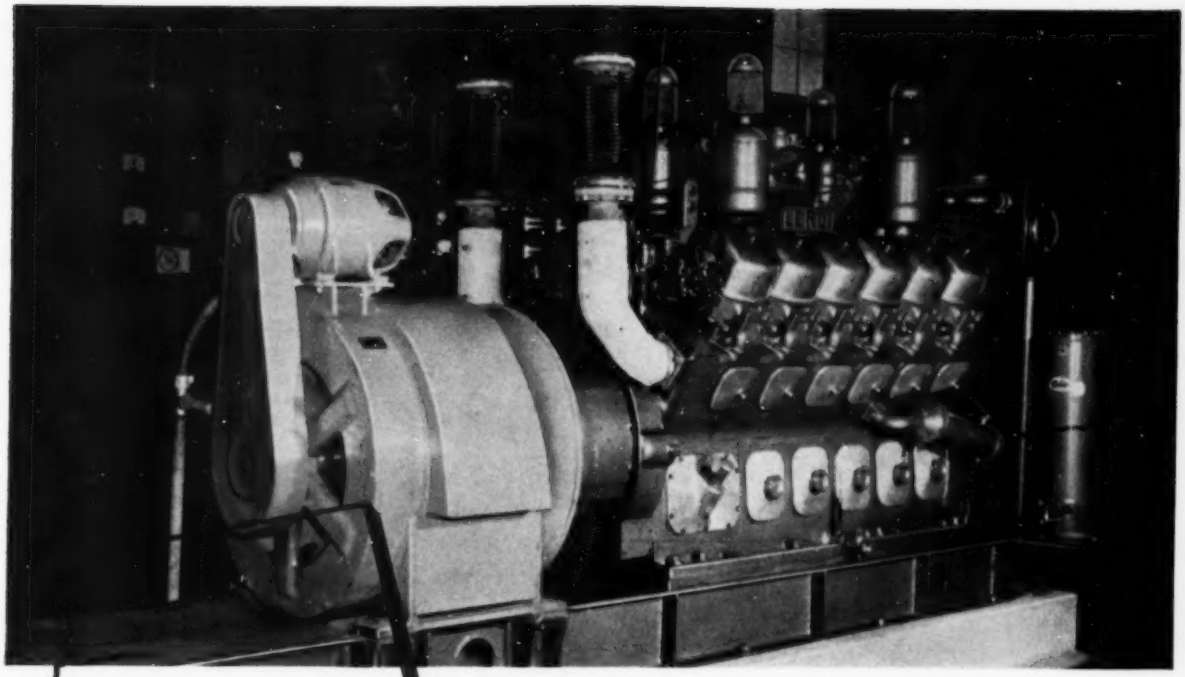
Water is but one of hundreds of fluids Crane Packless Diaphragm valves handle efficiently. Their sealed-to-fluid bonnet and "soft-seating" disc are ideal for all sorts of hard-to-hold liquids and gases; also for sludges, slurries, etc. Separate disc and diaphragm design saves diaphragm wear; permits tight seating even should diaphragm fail. Choose these valves from a wide range of materials, lined or unlined body, for corrosive or ordinary applications. See your Crane Catalog, or your Crane Representative.

*THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON*

# CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
*Branches and Wholesalers Serving All Industrial Areas*

**VALVES • FITTINGS • PIPE • PLUMBING • HEATING**



**Power for Prentiss, Miss. less than 5 mills per KWH!**

## . . . and LE ROI L3460 ENGINE saves enough on operating costs to pay for itself in about 3½ years

MUNICIPAL power requirements — for pumping, for generating electricity, for standby service — cost less with Le Roi engines. The Le Roi installation at Prentiss, Mississippi is a good example:

In order to meet the demands of an increasing electric load, Prentiss has supplemented its old diesel-powered generating plant with a Le Roi L3460. Burning natural gas, this Le Roi produces power for less than $0.005 per KWH — about one-half the cost with diesel power.

The Le Roi engine runs continuously in 600-700-hour periods between oil changes. Savings on fuel and lubricating oil amount to around $550 per month, allowing the Le Roi to pay for itself in about 3½ years.

Use dependable, low-cost Le Roi power to help ease the tax load in *your* community. Le Roi engines are available in sizes from 20 to 600 hp — custom generator sets in sizes from 50 to 300 KW. They operate on no-cost sewage gas, natural gas, butane, or gasoline.

E-85

**Write today for detailed information**

LE ROI

**LE ROI COMPANY**

Dept. WA-8 • 1706 S. 68th St. • Milwaukee 14, Wis.

*A Subsidiary of Westinghouse Air Brake Co.*

Plants: MILWAUKEE CLEVELAND GREENWICH, OHIO

*A few of the Darling gate valves now serving a recently built pumping station in the Southwest. Included are 20" O. S. & Y. valves as well as 30" and 36" sizes with beveled gears and gear cases. All employ Darling's unique revolving double disc feature and comply with A. W. W. A. specifications.*

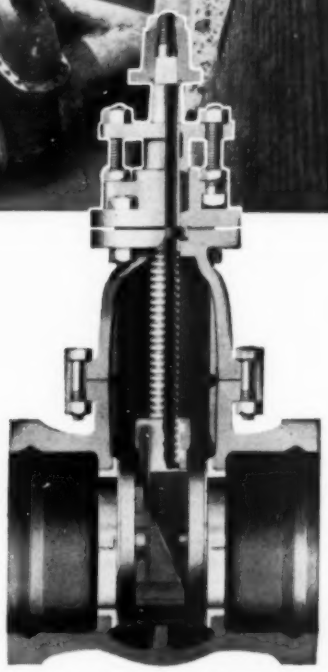
# Planned Economy...

## with Darling fully revolving double disc gate valves

IN water and sewage plants, there's a sure-fire way to plan for years and years of lowest-cost gate valve performance. That's the experience in plant after plant where Darling fully revolving double disc, parallel seat gate valves are on the job.

These valves come closer to being trouble-*proof* than any you've ever run across. In the event of valve body distortion, the unique wedging feature *automatically* adjusts discs to seats for drop-tight closure. And to cinch prolonged, low-maintenance service, wear is *uniformly* distributed because the fully revolving discs take a *different seating position* at every closure!

It adds up to smooth, reliable operation, and greater service life with minimum attention. But why not get *all* the facts on how Darling valve features can work to your advantage?



*Note rugged simplicity of this unique Darling principle—just four sturdy working parts . . . two plain interchangeable no-pocket discs and two husky wedges. Assembly and maintenance is extremely easy and foolproof.*

**SEND FOR BULLETIN No. 5002**

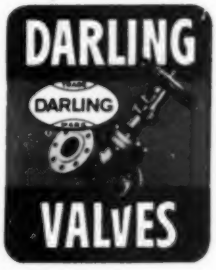
Darling's latest bulletin is full of helpful information and describes Darling valves for every normal or unusual service . . . yours for the asking.

**DARLING VALVE & MANUFACTURING CO.**

**Williamsport 11, Pa.**

*Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.*

**DARLING VALVES FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN**



# ADVANCED BADGER ENGINEERING

## brings you the DOVETAIL THRUST ROLLER INSERT

Because BADGER METER engineers refuse to "rest on their laurels," they continue to maintain the world's highest standards of water meter performance. This new Badger Dovetail Thrust Roller Insert is typical of the constructive research and precision achievements in progress continually at BADGER.

What does this Badger Dovetail Thrust Roller Insert accomplish? It saves important time and replacement costs . . . because, with this removable plate set into the chamber wall, the thrust roller (in the disc) rolls against the *insert* only . . . thus preventing wear directly in the chamber thrust roller *slot* (which would damage the chamber itself). If wear occurs on the *insert,* that is no problem, because it can be replaced easily, at a small fraction of the cost and time required to replace an entire new chamber.

In addition, advanced Badger engineering of this unique insert assures you of accurate metering through unimpaired freedom of disc movement, because:

1 Both halves of chamber remain stronger, since this insert requires only a short slot (about 77% shorter slot milled in chamber wall).

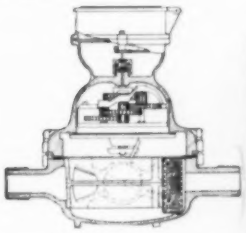
2 Precision design and machining permit insert to be held accurately and securely in place between the two halves of the chamber.

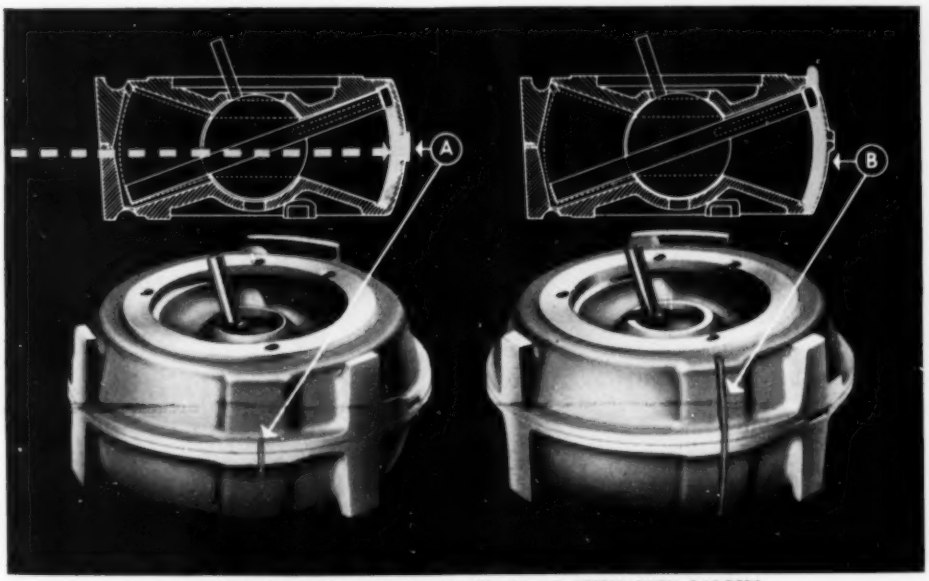
3 The precision dovetail design prevents insert from shifting or moving.

4 The increased radius of the insert along the area nearest the disc, assures ample clearance always between disc and insert, even in the extreme allowable vertical shift.

Only in BADGER METERS will you find this advanced type of engineering and precision production which has convinced waterworks men in over 5000 communities that "BADGERS are the best buy in meters."

. . . another BADGER-*First*"





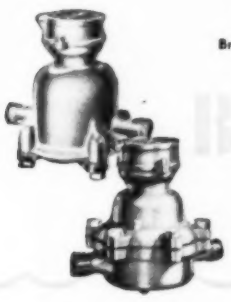

**A** New style: 77% shorter slot...adds strength to chamber-halves; prevents distortion. Dovetail prevents shifting of insert. Increased radius assures freedom of disc movement. No wear on chamber; wear confined to the easily replaceable insert.

**B** Old style: This full length slot weakened the chamber-halves . . . made them subject to distortion.

ASK ABOUT OTHER REASONS WHY YOU'LL DO BETTER WITH BADGERS

**BADGER METER MFG. CO., Milwaukee 45, Wis.**

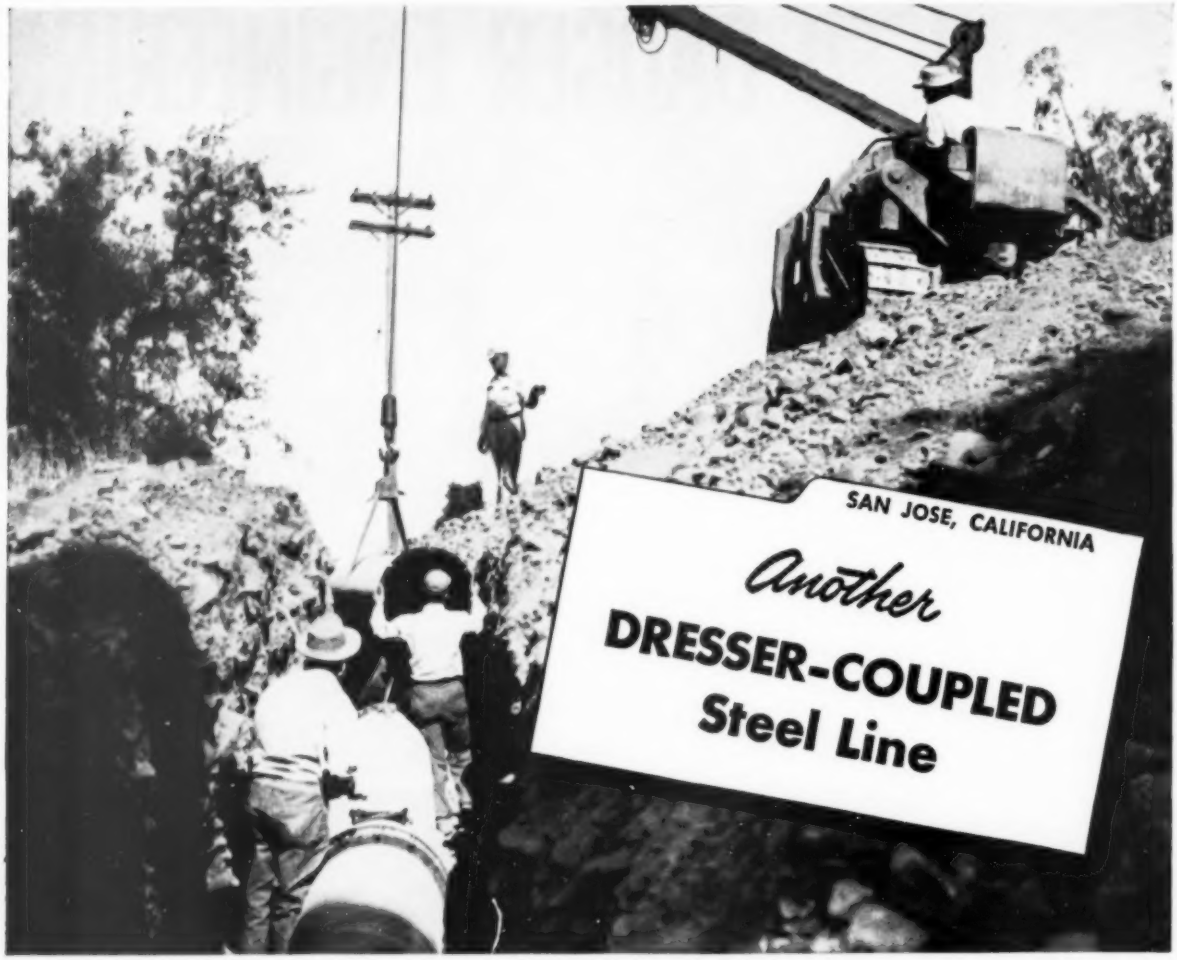
Branch Offices: New York City • Philadelphia • Worcester, Mass. • Savannah, Ga. • Cincinnati • Chicago • Kansas City
Waco, Texas • Salt Lake City, Utah • Guthrie, Okla. • Seattle, Wash. • Los Angeles



BADGER *Water* METERS

**"MEASURING THE WATER OF THE WORLD"**

**FOR ACCURACY • LOW-COST MAINTENANCE • DURABILITY • SENSITIVITY**




# DELIVERS WATER CHEAPER

**San Jose installs 12-mile Dresser-Coupled steel line . . . augments water supply from new reservoir.**

Crossing the new Water Conservation District reservoir—replacing 8,000 ft. of flume, now submerged—this Dresser-Coupled steel line carries an increased water supply to San Jose, Los Gatos and Saratoga, California. Having installed over 200 miles of steel pipe since 1946, San Jose engineers are well acquainted with the many advantages of Dresser-Coupled construction.

The beam strength of lighter weight steel pipe, plus the resilience of both pipe and couplings, assures a permanently tight line unaffected by surface shock, ground shift or washouts. Rugged coatings make the line impervious to corrosion and incrustation. Glass-smooth pipe linings sustain high flow-coefficients.

Long pipe lengths require fewer joints per mile —reduce laying costs. Small crews, with a minimum of skill, supervision and heavy equipment, make Dresser joints faster, surer—speed construction schedules. This adds up to lower cost, maintenance-free lines.

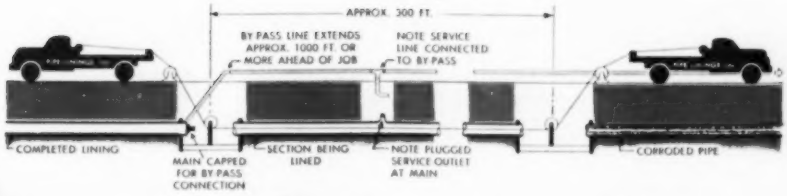
***BE SURE*** **you get the *best* line at the *best* price. Always put steel pipe and Dresser Couplings in *your* specifications.**

**DRESSER® COUPLINGS**

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: Toronto, Ont.

**this** ***is an Indian peace pipe...***

The American Indian knew the pleasures to be obtained from smoking long before the European world. He fashioned his crude pipe stem from cane, reed or bone and the bowl from stone, clay or hard wood. But contemporary Indian fighters who tried smoking the peace pipe reported it took a lot of lung power to draw through the rough stems. Compared to our modern pipe, smoking was hard work . . . and not the pleasant, "easy-draw" smoking pipe smokers enjoy today.


APPROX. 300 FT.
BY PASS LINE EXTENDS APPROX. 1000 FT. OR MORE AHEAD OF JOB
NOTE SERVICE LINE CONNECTED TO BY-PASS
COMPLETED LINING
MAIN CAPPED FOR BY PASS CONNECTION
SECTION BEING LINED
NOTE PLUGGED SERVICE OUTLET AT MAIN
CORRODED PIPE

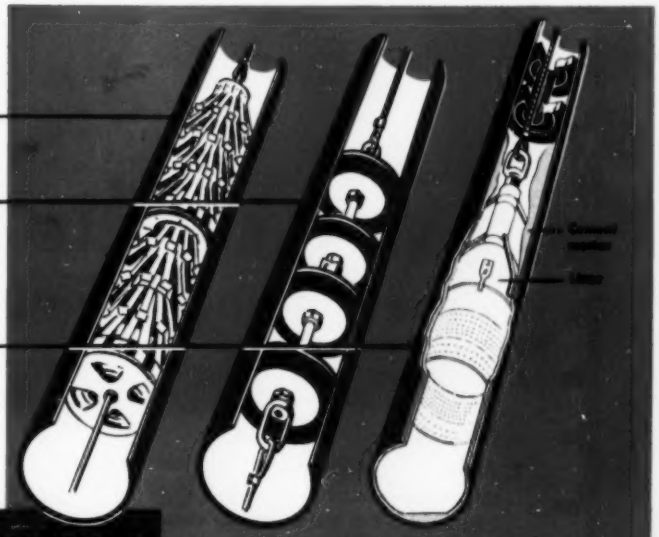
**this** ***is a pipe lining operation...***

...applicable to water, oil or gas pipe lines...using the Tate Process to renew old iron and steel pipe "*in place*," up to 16" dia., with only temporary interruption of service while by-pass sections are installed.

**this** *is the steel scraper* . . . pulled through the pipe to dislodge all tubercles and incrustation.

**this** *is the rubber swabber*...drawn through the pipe after the scraping operation to make sure pipe is clean and smooth and all loosened material is removed.

**this** *is the Tate Process liner* . . . it squeezes cement mortar inside onto the pipe walls, making a smooth, continuous water proof lining for free, fast flow.



**When your underground pipe line looks like this**

**The Tate Process makes it look like this!**

**CEMENT MORTAR LINING GIVES YOU**

- New pipe performance!
- Restores flow coefficients!
- Reduces pumping and maintenance costs!
- Prevents leakage!
- Protects against corrosion, contamination and discoloration!
- At much less than the cost of installing new pipe!

Pipe Linings, Inc. offers "in place" Tate Process lining service for pipe 4" to 16" and "in place" Centriline Process lining service for pipe 16" to 144". Expert, trained crews. Complete mobile equipment and facilities.

A Pipe Linings hydraulic engineer will be glad to help you. No obligation!

Write today for details on handy coupon.

# PIPE LININGS, Inc.

*4675 Firestone Blvd., South Gate, California*

(A subsidiary of American Pipe and Construction Co.)

PIPE LININGS, Inc., 4675 Firestone Blvd., South Gate, California

( ) Please send complete information on how to obtain new pipe line performance from our old pipe.

( ) Please have one of your hydraulic engineers see me.

Name _____

Title _____

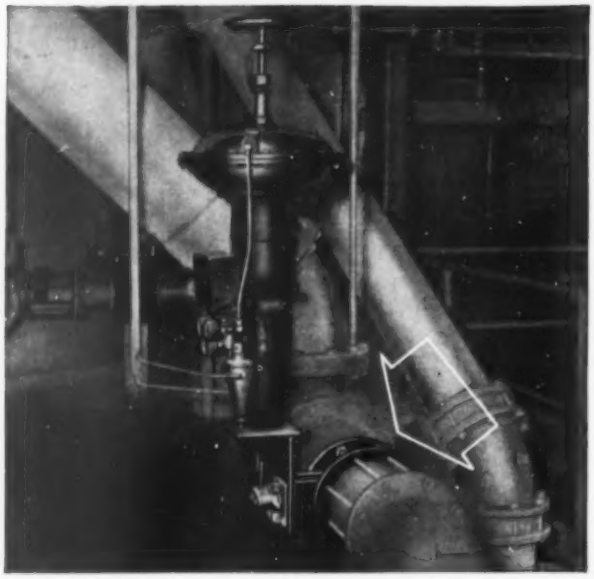
Company _____

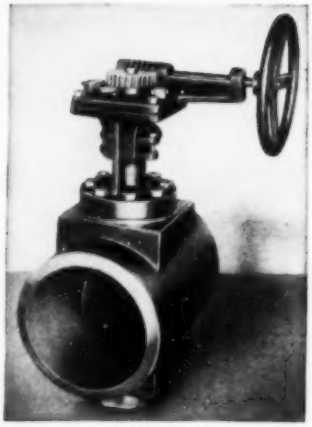
Address _____

City _____ State _____

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •





No. 677-A—1500-pound welding-end steel valve for superheated steam service. A. S. M. E. standards with heavy duty handwheel control.

# R-S VALVE ADVANTAGES
## Under Automatic Control

1. Wide range of throttling from open to closed position. 30 to 1 is standard. Minimum torque required for positioning.
2. Any type of instrument or control actuator can be used depending on preference and conditions. In any application, the R-S Valve usually costs less to purchase, less to install and results in lower pumping costs due to simplicity of design.
3. R-S Valve design offers no pockets to capture sediment, no change of flow-direction to create turbulence. Freedom from turbulence reduces erosion and cavitation and therefore adds to the life of the valve.

R-S Valves are used for regulation, pressure reduction, liquid level control, flow control, shut-off and other functional applications.

No. 864—30-pound valve equipped with rubber seat, extended shaft, thrust bearing, floor stand and heavy duty handwheel control.

Consult your local R-S Valve Engineers, or write direct.

**R-S PRODUCTS CORPORATION • 4600 Germantown Ave., Philadelphia 44, Pa.**

*An S. Morgan Smith Company Subsidiary*

REPRESENTATIVES IN PRINCIPAL CITIES

# SEWAGE CORROSION costs more than you think!

## Stop it now with Economical PITT CHEM Tar Base Coatings!

**Sewage corrosion is an insidious destroyer. It works silently around the clock . . . eating away at your capital investment in sewage equipment and plant. And you can't stop sewage corrosion with ordinary paints.**

**But Pitt Chem Tar Base Coatings are not ordinary paints. They're tough, durable protective coatings made from coal tar pitch—one of our most impervious materials. And they are up to 10 times as thick as ordinary paints. That's why leading sewage plant engineers acclaim them as the most satisfactory of all types of coatings for combating sewage corrosion. Pitt Chem Coatings are easy to apply and form an excellent bond with metal, cement and masonry. No other material does such a complete job of protection at so little cost. ● Write today for recommendations on your specific problems.**

W&D 4779

*Write For FREE Corrosion Control Booklet*

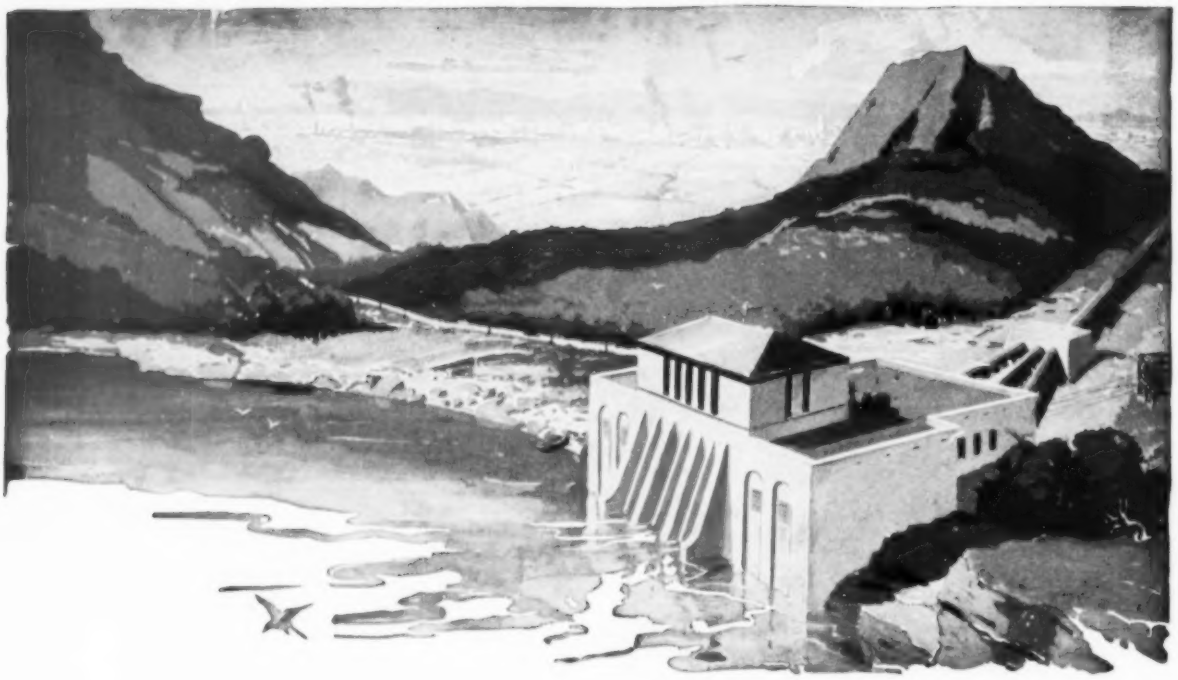
**Tells where tar base coatings can save you money in your plant . . . what grades to use . . . how to apply them.**

PROTECTIVE COATINGS DIVISION

**PITTSBURGH COKE & CHEMICAL CO.**

Grant Building · Pittsburgh 19, Pa.

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON



# WHEN Millions Live As One

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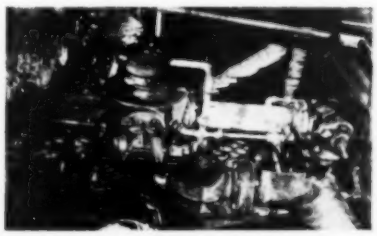

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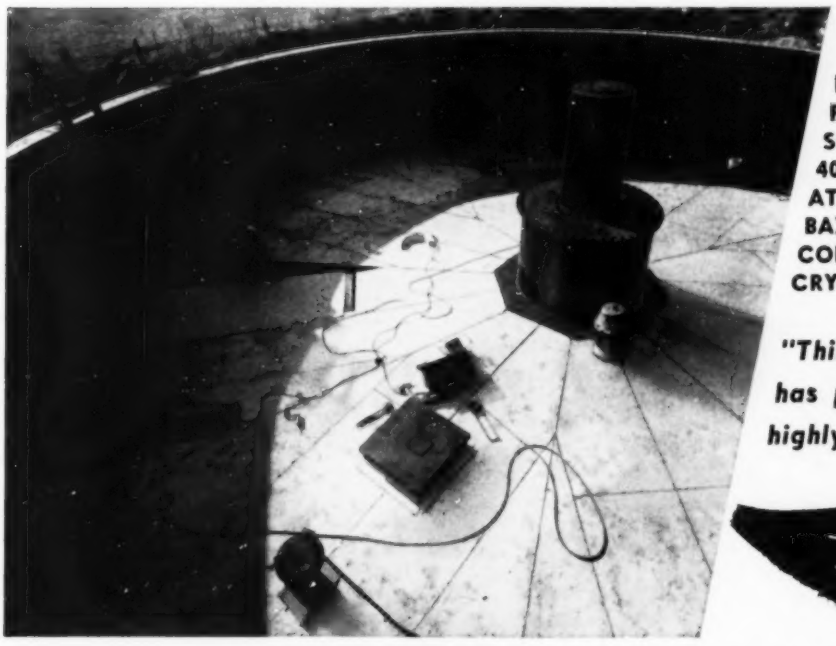

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VOL. 100, NO. 8 WATER & SEWAGE WORKS AUGUST 1953

# The Case for Sludge As a Soil Improver

## With Emphasis on Value of pH Control and Toxicity of Minor Elements

*by* **HERBERT A. LUNT,** ***Soil Scientist, The Connecticut Agr. Expt. Station, New Haven, Conn.***

RECENTLY a city manager in our State requested information on the value of sewage sludge for soil treatment. What prompted the inquiry was his pending decision on the design of a municipal sewage treatment plant.

Now the subject of sludge utilization in agriculture has been rather extensively treated in the literature*, yet there are many questions still to be answered. Furthermore, although our interrogator may be familiar with results obtained, say, in Minnesota, Illinois or Texas, he wants to know what the score is in Connecticut.

*In addition to the literature reported in the Manual of Practice No. 2 Federation of Sewage Works Association, 1946, the reader is referred to articles in this magazine in 1947, '48, '49, '51 and '52, and to the following references:

Stephenson, R. E. and Bollen, W. B., Soil Science Soc. Amer. Proc. 10:168. 1945.

Bear, Firman E. and Prince, Arthur L., New Jersey Agri. Expt. Sta. Bul. 733. 1947.

Odland, T. E., et al. Waste Conversion Committee Report, State of Rhode Island and Providence Plantations. (R. I. Agr. Exp. Sta.) March 1948.

Allegheny County Sanitary Authority. Report on the proposed collection and treatment of municipal sewage and industrial wastes. Pittsburgh, Pa. 1948.

Inter-Departmental Committee on Utilization of Organic Wastes, Second Interim Report. New Zealand Engineering 6, Nos. 11-12: 1-42. 1951.

During the past few years our work at this Station has included study of Connecticut sewage sludge as a phase of an overall investigation of waste organic matter for soil improvement. We set out to see (a) if sludge would increase crop yields, (b) if sludge has an overall beneficial effect on the soil, and (c) what other effects, if any, sludge has on the plant.

The experimental procedure usually followed was to apply fresh sludge to the soil and work it in, and at the same time apply a more or less standard treatment of commercial fertilizer such as 5-10-10 at fairly righ rates as is customary in market gardening. If lime was needed, it too, was added at the same time. The seed was sown

*Summary*

Our studies show quite conclusively that, under conditions of the experiments, digested sewage sludge from typical treatment plants in Connecticut has a very favorable effect on the properties of the soil. This was evidenced by moderate increases (3 to 23 per cent) in field moisture capacity, non-capillary porosity, and cation exchange capacity; in organic matter content up to 35 or 40 per cent; in total nitrogen up to 70 per cent, and in soil aggregation ranging from 25 to nearly 600 per cent. As a rule, greater benefits occur in sandy soil than in loams.

It has been found that most of the sludges tested had a tendency to delay germination of lettuce, spinach, beet, bean and oat seed; and fresh sludge seemed to have a more delaying effect than did sludge piled outdoors 6 months or longer. This need not be a serious difficulty in the field if sufficient time allowance is made for adequate germination. The possibility that the magnesium in dolomitic lime inhibits germination is being investigated.

The experiments have shown further, that Connecticut sludges contain rather high concentrations of boron, copper and, especially zinc, and that these elements may be toxic to beets and, especially spinach in acid soil, but not to grasses and small grains. Usually the injurious effects are eliminated by adequate liming. Sludges that are neutral or alkaline are less likely to be toxic.

In the nursery, 150 cu. yds. of an acid sludge had an unfavorable effect on red pine first year seedlings but not on spruce or white pine seedlings. Until further data have been obtained, it is presumed that sludge can be used safely and to advantage in nurseries if applied at moderate rates, say 40 to 60 cu. yds. per acre, and if the soil pH is not permitted to drop below about 5.3.

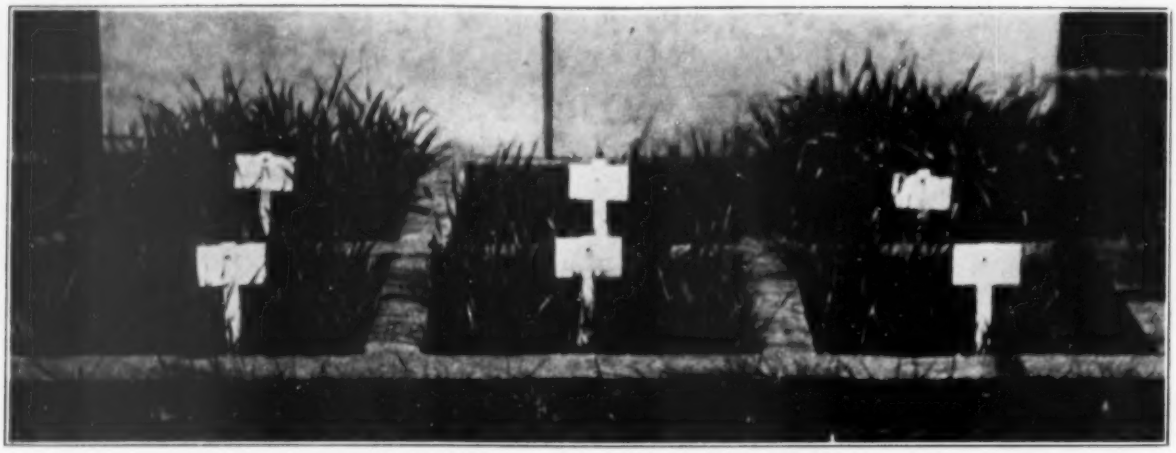

**Fig. 1—EFFECT of sludge and wood chips on growth of oats, Cheshire loam soil**

Back row illustrates application (tons per acre) of Torrington sludge (29 tons); oak chips (20 tons); New Haven sludge (36 tons). Front row: soil plus extra nitrogen; soil only; birch chips (20 tons).

within a day or two. The soil was successively cropped, usually to spinach and beets alternately. No further applications of sludge were made but commercial fertilizers were applied as needed. In some cases rye or oats was seeded as a cover crop. Later on oats and beans were grown on an acid soil series.

These experiments were carried out (a) in two-gallon greenhouse pots, (b) in outdoor concrete soil boxes or frames (without bottoms, i.e. the soil in the frames rested directly on the natural subsoil), and (c) in small field plots.

## General Character of the Sludges Used

The two sludges chosen for the initial work were from the cities of New Haven and Torrington. New Haven sludge produced in the Boulevard plant, is primary digested sludge conditioned with ferric chloride and lime for vacuum filtration. As taken from the conveyor belt the pH is about 11, but upon standing it drops to 7.5 or 8.0. It normally contains industrial wastes originating largely from textile dyeing works.

The Torrington sludge is also a primary digested sludge but instead of being chemically conditioned for filtering, it is air-dried on open sand beds. It contains industrial wastes originating principally in textile and metal industries.

Upon completion of the digesters at the West Haven plant in 1951, some experiments were started with sludge from that source. West Haven sludge is a primary digested sludge elutriated and then conditioned with ferric chloride for vacuum filtration. It contains no appreciable industrial wastes.

Finally, in some of the 1952 experiments a flash-dried raw sludge from Waterbury was added. This sludge contains industrial wastes originating chiefly in metal industrial plants. The principal characteristics of these sludges are tabulated in Table 1.

## Variable Response of Plants to Sludge

Our earlier work, (1943-1946) had shown disconcertingly variable results, ranging from appreciable yield increases on the one hand to retardation of growth on the other. The present study in its initial stages showed similar variabilities. In the first experiment in the greenhouse with Cheshire loam soil, both New Haven and Torrington sludges resulted in reduced yields of beet roots, although top growth was satisfactory. Later beet crops showed gradual improvement and, in the last crop, beet root yields were increased 7 to 22 percent by the sludge treatment. Spinach was particularly poor, the first crop being almost a complete failure.

On the other hand, our outdoor experiments in the soil frames with similar soil showed New Haven sludge producing the highest yields, 81 to 86 per cent better than the checks, and Torrington sludge the lowest,—in some cases a complete failure. The second year's crop (1951) followed the same pattern. And on the field plots at the farm on Cheshire loam soil, New Haven sludge produced higher corn yields than the checks (no Torrington sludge was used on these plots).

Table 1

PRINCIPAL CHARACTERISTICS OF THE SLUDGES USED IN THE EXPERIMENTS

| Source of Sludge | | New Haven | Torrington | West Haven | Waterbury |
|---|---|---|---|---|---|
| Type of Sludge | | Digested; $FeCl_3$ and lime; vacuum filtered | Digested; air dried on sand beds | Elutriated, digested; $FeCl_3$; vacuum filtered | Flash-dried, raw |
| Moisture content as sampled: | | | | | |
| (As delivered) | A.D. % | 72 | 69 | 71 | 8.5 |
| (Water-free basis) | W.F. % | 257 | 223 | 245 | 9.3 |
| pH as used | | 7.5 | 5.6 | 6.0[1] | 7.9 |
| Loss-on-ignition | W.F. % | 41.7 | 43.2[2] | 56.4 | 71.0 |
| Total nitrogen | A.D. % | 1.50 | 2.29 | 2.48 | 1.55 |
| Organic carbon | A.D. % | 28.8 | 27.8 | 35.9 | 50.4 |
| C-N ratio | | 19.2 | 12.1 | 14.5 | 32.5 |
| Calculated organic carbon[3] | | 23.2 | 24.0 | 31.3 | 38.6 |
| Calculated C/N | | 15.5 | 10.5 | 12.6 | 24.9 |
| Total phosphorus | A.D. % | 0.67 | 0.58 | 0.60 | 0.50 |
| Total potassium | | VL[4] | VL | VL | VL |
| Total calcium | A.D. % | 4.33 | 1.13 | 1.88 | 3.60 |
| Total magnesium | A.D. % | 0.26 | 0.18 | 0.14 | 0.17 |
| Cation exchange capacity | A.D. me/100 gm. | 25 | 27 | 32 | 23 |
| Weight per cu yd as delivered | lbs. | 1085 | 1450 | 1210[5] | 428 |
| Weight per cu yd waterfree | lbs. | 300 | 627 | 350[5] | 404 |
| Presence of industrial waste | | Some textile dyes | Wool scouring and metal plating wastes | No appreciable amount | Large amounts of metal plating wastes |

[1]Subsequent samples tested 5.2 and 4.5
[2]Av. of 6 samples which ranged from 29 to 51%
[3]Loss-on-ignition 1.8 = organic C. (A simple approximate method used in New Zealand for estimating the organic carbon content of sludges).
[4]VL = very low
[5]Estimated

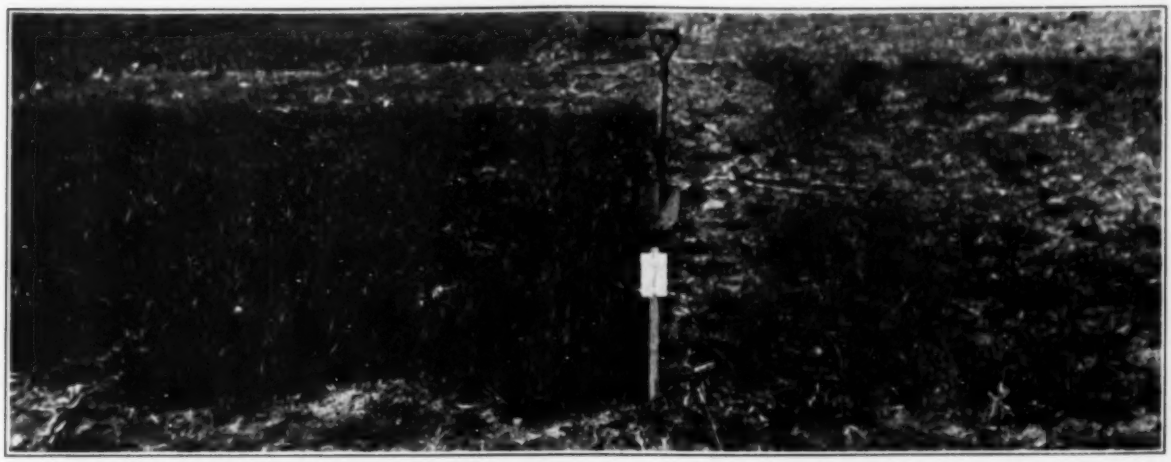

**Fig. 2—EFFECT of sludge on growth of rye, Cheshire loam soil**

Illustrated on left side of photo is effect (tons per acre) of Torrington sludge (17.5 tons or 68 cu. yds.) on right side, wood chips and sludge compost (68 cu. yds.).

Admittedly the rates of application were high, particularly in terms of the amount of nitrogen applied. The original objective was to apply the same amount of organic matter as is present in 10 and 20 tons of dry wood chips. To apply 10 tons of organic matter meant using about 20 tons (dry weight) of New Haven sludge and 35 tons of Torrington sludge[1] per acre. The fact that under certain conditions excellent yields were obtained indicates that the rates of application were not excessive.

## Influence of pH

But why was New Haven sludge detrimental in some cases and very favorable in others? Fortunately the answer was soon found: the pH of the soil. The alkaline New Haven sludge effectively held up the pH in the frames, but due to the artificial condition in the greenhouse the sludge did not prevent acidification of the potted soils. On the other hand, the acid Torrington sludge contained no lime to deter the development of a more acid condition as nitrification progressed.

Now every experienced gardener knows that neither spinach nor beets thrive on strongly acid soils. But we found that the plants growing on the sludge treated acid soils were even poorer than those on the check soils, likewise acid, which suggests a toxic factor in the sludge. This idea was further supported by the fact that freshly applied sludge seemed to interfere with seed germination. During the early stages of growth in the greenhouse one could readily pick out the sludge treatments by the appearance of the seedlings (fewer and smaller), and in a test with lettuce seed[2], germination was reduced to as low as two percent as compared with 60 per cent for the checks. Further, when blotting papers used in germination tests were saturated with infusions from water extracts of sludges, seed germination was seriously inhibited[2]. In both cases, Torrington sludge had less effect than did New Haven sludge.

Another example of variable response of plants to sludge treatment comes from our field plot experiment on Merrimac sandy loam in Peoples Forest Nursery, Barkhamsted, Connecticut. Here, Torrington sludge was applied to small plots at the rate of 50 and 150 cu. yds. per acre, along with fertilizers but without lime. (Nursery soils should be acid.) The plots were seeded to four forest tree species—Norway spruce, white spruce, red pine and white pine. This was in the fall of 1951.

Observations a year later showed no effect from the 50 cu. yds. rate. The high rate, however, tended to cause somewhat thinner stands and slightly smaller seedlings of the spruces and white pine; and in the case of red pine, conspicuous red tipping of the needles and a poor stand generally.

Before exploring the toxicity angle, two more observations should be made. Firstly, in all our experiments, grasses and small grains (Fig. 1) have responded well to sludge, whether the soils were acid or neutral. (No data were obtained on yields of thrashed grain but this is not a practical problem in Connecticut, for little or no grain is harvested). Where sludge was applied in December to a rye cover crop on field plots, the plants were larger and a deeper green and the stand thicker, at the time of spring plowing, than were the plants without sludge (Fig. 2). Lawn grass topdressed with screened New Haven sludge increased in growth and in depth of color. Thus it is obvious that

[1]This particular sample contained only 30% organic matter.

[2]Experiments by J. P. Hollis, formerly of the Dept. of Plant Pathology.

Table 2

MINOR ELEMENT CONTENT[1] AND pH OF CONNECTICUT SEWAGE SLUDGES AND OF OTHER ORGANIC MATERIALS

| Source | B ppm | Cu ppm | Mn ppm | Zn ppm | pH |
|---|---|---|---|---|---|
| Bristol | 210 | 540 | 210 | 3570 | 6.06 |
| Hartford | 360 | 830 | 280 | 3200 | 5.40 |
| New Haven | 190 | 830 | 190 | 3280 | 7.50 |
| Torrington | 160 | 1025 | 135 | 3170 | 5.70 |
| West Haven | 225 | 465 | 105 | 2200 | 6.16 |
| Waterbury | 265 | 760 | 170 | 2540 | 7.90 |
| Av. of Municipal plants[2] | 211 | 758 | 172 | 3205 | 6.12 |
| Av. of State Institutions[3] | 148 | 535 | 110 | 2433 | 5.82 |
| Milorganite | 1080[4] | 500 | 170 | 2000 | 5.05 |
| Peat Moss | 31 | 24 | 30 | Trace | 4.00 |
| Cow Manure | 38 | 61 | 150 | 210 | |
| Peat Soil | 50 | 5 | 40 | Trace | 5.50 |
| Forest litter (hardwoods) | 40 | 54 | 2800 | 150 | 4.50 |

[1]Determined on the spectrograph by W. T. Mathis
[2]25-31 samples from 13 plants
[3]6 samples from 5 plants
[4]This high value is open to question

**Fig. 3—EFFECT of high applications of zinc sulfate and copper sulfate on beets. Hartford loamy sand**

Top row, limed soil; bottom row, acid soil. Left to right illustrates soil only; high zinc; very high zinc; high copper; very high copper.

crops differ in their response to sludge treatment.

The second observation is that our studies have shown no evidence of root injury of lettuce and radish seedlings[2] caused or aggravated by sludge treatment.

### Minor Element Toxicity

The forementioned unfavorable effects of sludge led us to have the sludges analyzed and later to make further germination tests. These analyses showed appreciable quantities of boron, copper and zinc, the latter reaching a concentration of over 5000 ppm (parts per million) in two instances. Table 2 shows the principal minor element content and the pH of several typical Connecticut sludges from municipal plants, and the averages from State institutions. For comparison, data are included for some organic materials commonly applied to soil. It is readily seen that all the sludges (including Milorganite) are much higher in boron, copper and zinc than are the other organics. It is also evident that municipal sludges contain larger amounts of these constituents than do the institutional sludges, although the differences are much smaller than had been anticipated.

Analysis of ammonium acetate extract of the soils to which sludge had been applied showed some increase in available copper and about double the concentration of available zinc. Then we analyzed the plants—spinach, beets and oats—and found that all those growing in sludge-treated soil contained a little more copper and a lot more zinc, the latter ranging from 300 to 1200 per cent increase. Boron was not affected appreciably. Recently, an analysis of tomato plants growing on a sludge dump in South Manchester, Connecticut, showed the plants to contain five times as much zinc and twice as much copper as plants not in contact with sludge. (The tomato plant is remarkably tolerant of these elements.)

As a further check on toxicity of copper and zinc, varying amounts of copper sulfate were applied to soil in small flower pots, one series being kept acid and the other treated with lime; and a similar test was made with zinc sulfate. The results on the acid soil, illustrated in Fig. 3, showed retardation of growth, and also injury characterized by yellowish leaves of spinach and red to yellowish-red leaves of beets—the same as observed from *sludge* treatment in acid soil. Of the two metals, copper seemed to develop the more characteristic symptoms, but both were equally toxic.

One more remark on minor element toxicity should be made at this point. Considering the amounts of these metals applied in the sludge treatments, it is not surprising that injury occurred. Table 3 shows the estimated amounts of boron, copper, manganese and zinc applied in 10 tons of average sludge, based on our analyses. Of the four, zinc was by far the highest, being in excess of a safe application, especially when larger amounts of sludge were used.

However, not all of the zinc in sludge is immediately available to plants, even in acid soils. Further, the buffering effect of organic matter tends to reduce the amount of injury. Thus a given amount of a soluble toxic substance is less injurious in the presence of appreciable amounts of organic matter.

### Source of Minor Elements

Now for the $64 question, "Where do these minor elements come from?" The answer is simple where industrial wastes are dumped into the sewer system, but as our analyses show that sludges free of such wastes also contain rather high amounts, it is necessary to look for other sources. Copper, brass and galvanized piping undoubtedly contribute some copper and zinc, and wherever these metals form insoluble compounds with phosphorous or lime they would appear in the sludge.

There are indications, however, that appreciable amounts of these minor elements come from food stuffs. Bertrand and Benzon[3] reported zinc in fresh material ranging from less than one ppm in peaches, plums and melons to 50 ppm in legumes. Hegsted et al[4] reporting data from others, show that ordinary foods contain variable amounts of zinc, ranging up to 145 ppm on a dry basis. Yeast, mushrooms and seafoods are high, and oysters may contain as much as 2300 ppm. The daily intake of zinc in a normal diet averages about 10 mg per day per person, but it would be possible to eat a meal of selected foods which would supply 225 to 275 mg of zinc. The important fact is that practically all

[3]Bertrand, G. and Benzon, B. The control of zinc in the principal foods of vegetable origin. Bul. Soc. Sci. Hyg. Aliment. 16:457-463, 1928, and Ann. inst. Pasteur 43:386-393, 1929. (Abs. seen in Bib. Minor Elements, 4th Ed. Vol. I:938, 1948).

[4]Hegsted, D. Mark, McKibbin, John M., and Drinker, Cecil K. The biological, hygenic and medical properties of zinc and zinc compounds. Supplement No. 179 to the Public Health Reports, U.S. Public Health Service, Washington, D.C. 1945.

Table 3

APPROXIMATE AMOUNTS OF BORON, COPPER, MANGANESE AND ZINC APPLIED IN SEWAGE SLUDGE AND THE AMOUNTS USUALLY RECOMMENDED FOR DEFICIENT SOILS

| Average concentration in sludge | | Approximate amount applied in 10 tons[1] of dried sludge | | | Usual recommendation for deficient soils. Salt equivalent |
|---|---|---|---|---|---|
| Element | ppm | Elements lbs. | Salt equivalent lbs. | | lbs. per acre |
| Boron | 210 | 4.2 | 37 | Borax | 5-30, occa. 100 |
| Copper | 760 | 15.2 | 60 | Copper sulfate | 20-200 |
| Manganese | 170 | 3.4 | 14 | Manganese sulfate | 25-60 |
| Zinc | 3200 | 64.0 | 281 | Zinc sulfate | 20-40, occa. 200 |

[1]10 tons per acre of dried sludge is equivalent to about 33 tons of moist sludge or 52 cu. yds. (Torrington sludge, 28 + cu. yds.)

of the zinc ingested is excreted, of which over 90 per cent is in the feces.

## Germination Experiments

To check further on sludge retardation of germination, several experiments[5] with lettuce seed were run in petri dishes in 1952 using Hartford loamy sand treated with four different sludges at rates of 16, 48, 144 and 240 cu. yds. per acre with and without lime. Also additional germination readings were obtained in existing pot cultures in the greenhouse on lettuce, spinach, oats and beans. Space permits only a brief summarization of the results.

Strangely enough, Torrington sludge favored germination in some cases, particularly where the sludge had been piled out of doors for about a year. Sludge piled only a month tended to delay germination when applied at the higher rates. All of the other sludges—New Haven, West Haven, and Waterbury—generally retarded germination to a degree ranging from 3 to 10 days in the petri dish tests, and 2 to 5 days in the pot cultures, although there were some instances of no delay. Generally speaking, germination was delayed rather than inhibited.

[5]Frances Meyer, Plant Path. Dept. assisted in this work.

**Fig. 4—EFFECT of sludge on growth of beets, Cheshire loam**
These illustrate: (B) check, acid soil; (C) check, limed soil; (M) Torrington Sludge, acid soil; (N) Torrington sludge, limed soil.

So far as could be determined, soil acidity was not a factor in germination, for good results were obtained at pH values as low as 4.5 and the addition of lime did not cause consistent improvement. In fact, lime was detrimental in some instances. Recent work points to the magnesium in the lime as the probable causative factor and this aspect is being investigated. (The lime used in these experiments was dolomitic hydrate).

Delayed germination has not been a problem in the outdoor experiments. Perhaps it did not occur, or perhaps it merely escaped our attention, but obviously the matter needs further investigation under field conditions. So far we have not learned what it is in sludge that affects germination.

Incidentally it is interesting to note the effects of the several sludges on soil reaction. Increasing the rate of application from 16 to 240 cu. yds. per acre (without lime) had almost no effect in the case of Torrington and West Haven sludges, but raised the pH by 2 to 2.5 units in the case of New Haven and Waterbury sludges.

## Plant Growth Studies

Once the detrimental effect of acidity in sludge-treated soils was recognized our experiments were modified accordingly. In one case the treatments of the Cheshire loam soil were changed to provide a range in acidity, and the cropping to spinach and beets was continued. Although the sludge-treated *spinach* plants were favored by liming, they did not grow as well as did those without sludge. On the other hand, *beet* yields were higher with sludge whenever the pH was 6.4 or higher. The beet plants shown in Fig. 4 are indicative of the response

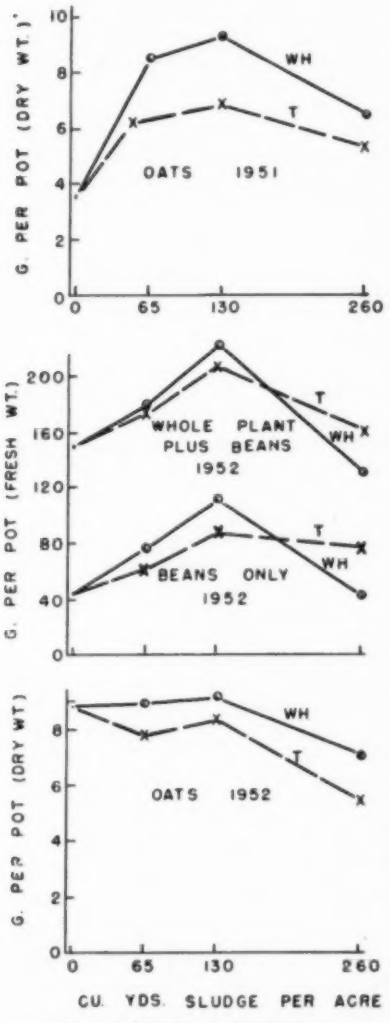


**Fig. 5—YIELD of succeeding crops, oats, beans, and oats affected by sludge**
Torrington (T) and West Haven (WH) sludges. Acid series. Hartford loamy soil.

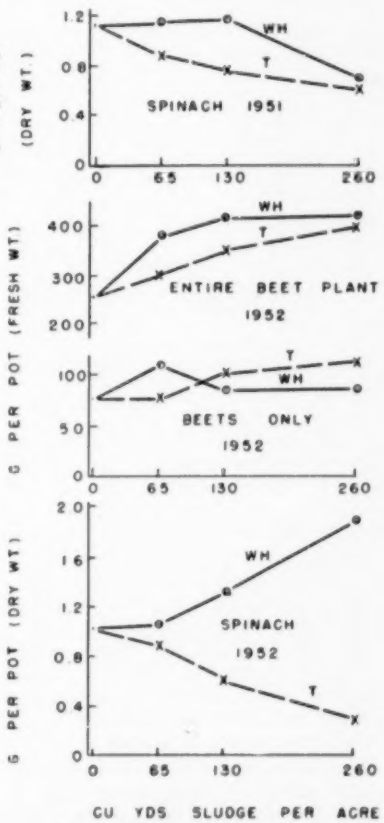


**Fig. 6—YIELD of succeeding crops, spinach, beets, and spinach affected by sludge**
Torrington (T) and West Haven (WH) sludges. Limed series. Hartford loamy sand.

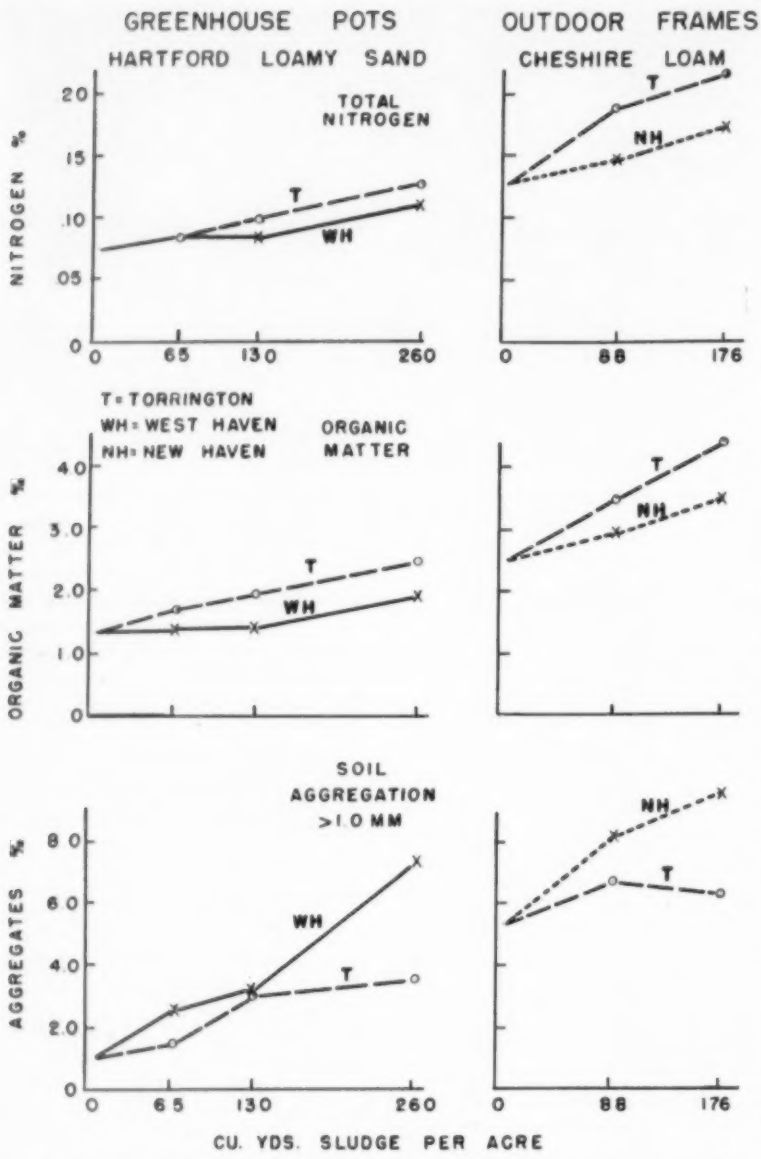


**Fig. 7—EFFECT of sludge on loamy sand soil in the greenhouse and on loam soil in outdoor frames**

Torrington (T) and West Haven (WH) sludges.

to two different pH levels in the presence of sludge.

In another experiment, Torrington and West Haven sludges were applied to Hartford loamy sand at rates of 65, 130 and 260 cu. yds. per acre (approximately ½-, 1-, and 2-inch layers, resp.) One set was maintained in an acid condition (pH 4.8-5.3), and cropped alternately to oats and beans. The other set was limed, then cropped alternately to spinach and beets.

Yield data of the acid series, Fig. 5, show that growth of the first crop of oats and of the succeeding bean crop was markedly increased by applying sludge up to the 130 cu. yd. rate, with a rapid falling off at the 260 cu. yd. rate. But the second oat crop was only slightly benefited by the low and medium rates of applied West Haven sludge, and was actually decreased by the Torrington sludge. No abnormalities occurred in the appearance of the oat plants at the high rate, but the bean plants receiving Torrington sludge developed a yellow mottling between the veins of the leaves, and those getting West Haven sludge showed a dying of the tissue (necrosis) of the same areas.

In the limed series, Fig. 6, the first crop of spinach was not benefited by West Haven sludge and was actually reduced by Torrington sludge. Tests showed that insufficient lime had been used, hence additional lime was applied as needed prior to seeding the succeeding beet and spinach crops. In the third crop, spinach, West Haven sludge caused marked increases, especially at the 260 cu. yd. rate, while Torrington sludge had exactly the opposite effect.

### Again pH Value Proves Important

Let's look at the pH of the soil after each harvest, as shown in Table 4.

Inspection of these data helps explain the difference in response of the two spinach crops to West Haven sludge. When the pH was brought well above 6, increases occurred. In the case of Torrington sludge, the pH remained about constant (over pH 6 in all cases), yet growth of the plants was reduced by the sludge. Probably the presence of industrial wastes in Torrington sludge makes the difference and thus precludes its use for spinach.

Now what happened to beets in our outdoor soil frames when the Torrington sludge soils were limed to correct the acidity? Where before, we had poor to very poor yields, now there were small increases, and the plants were normal in appearance. This is added proof that a low pH is particularly unfavorable in the presence of an acid sludge. (Spinach was not grown in the frames.)

### Residual Benefits

No residual benefits, so far as beet yields are concerned, were evident this third year from the original New Haven sludge treatment. Indications are that release of available nitrogen had about ceased and benefits to the physical condition of the soil were not great enough to be reflected in increased plant growth. Under less favorable growing conditions the story might be different.

On the other hand Torrington sludge benefits continued. Snapdragons were planted in these frames May 19, 1953. Ocular inspection early in June showed superior growth of the high rate of Torrington sludge (35 tons per acre, dry weight, applied in December 1949). No other differences could be detected at that time.

Before discussing soil improvement, mention should be made of experiments now in progress with a heat-dried *raw* sludge obtained from Waterbury. Although containing as much nitrogen as New Haven sludge, Waterbury sludge is higher in carbon and has a wider C-N ratio (Table 1). Also it has a higher grease content. The net effect of this raw sludge

in the soil is to cause considerable nitrogen deficiency initially, similar to the action of straw or sawdust.

Our study indicates that this N deficiency lasts only 2.5 or 3 months under greenhouse conditions. A beet crop harvested 6 months after the initial sludge treatment showed 15 to 19 per cent increase over the checks where the commercial fertilizer treatment included nitrogen; and 65 per cent increase where no commercial N was used.

## Soil Improvement

Our work has shown that grasses and small grains usually respond favorably to sludge applications, and that most other crops may likewise be benefited under the proper conditions. Although not all the factors responsible for these increases in production are known, it is certain that available nitrogen released by the sludge, and improvement in the physical condition of the soil are the chief causes.

The relative contribution of each is difficult to assess but soil studies readily show the effect of sludge on soil properties. Some of these are given in Fig. 7 and Table 5.

Increases in organic matter, in total nitrogen and in soil aggregation (Fig. 7) were substantial and definitely significant. Few other amendments are known which are as effective as sludge in this respect. Note that Torrington sludge was more effective than either New Haven or West Haven sludge in increasing organic matter and nitrogen but less effective in increasing soil aggregation, even though all three sludges were applied in equal quantities by volume. Possibly the more fibrous character of the latter two sludges is responsible for their greater effectiveness in aggregating soil particles. A well-aggregated soil means better aeration, greater ease of root penetration and increased rate of water infiltration. Therefore the beneficial effects depicted in Fig. 7 are very significant to agriculture.

Smaller but nevertheless important increases were found (Table 5) with respect to field moisture capacity, cation exchange capacity*, and non-capillary porosity; and there were decreases in bulk density, i.e. weight per cubic foot.

Table 4

Soil pH Values
After Harvesting Crops

| Succeeding crops<br>Cu. yd. sludge per acre | Check<br>0 | West Haven Sludge<br>65 | <br>130 | <br>260 | Torrington Sludge<br>65 | <br>130 | <br>260 |
|---|---|---|---|---|---|---|---|
| 1. After spinach | 5.9 | 5.6 | 5.5 | 5.4 | 6.1 | 6.2 | 6.2 |
| 2. After beets | 6.7 | 6.6 | 6.3 | 6.1 | 6.5 | 6.4 | 6.5 |
| 3. After spinach | 6.2 | 6.0 | 6.7 | 6.7 | 6.4 | 6.4 | 6.4 |

Table 5

Effect of Sludge Applications on Several Properties
of Chesire Loam
(Rates are expressed in cu. yards. per acre)

| | | Check (No Sludge) | New Haven Sludge<br>88 | <br>176 | Torrington Sludge<br>88 | <br>176 |
|---|---|---|---|---|---|---|
| Field moisture capacity | % | 24.4 | 25.1 | 25.8 | 27.2 | 29.9 |
| | Relative | 100 | 103 | 106 | 112 | 123 |
| Non-capillary porosity | % | 25.3 | 27.7 | 28.5 | 33.0 | 27.6 |
| | Relative | 100 | 109 | 112 | 119 | 109 |
| Cation exchange capacity | me/100g | 11.15 | 11.99 | 12.35 | 11.83 | 12.12 |
| | Relative | 100 | 107 | 111 | 106 | 109 |
| Bulk density (water = 1.0) | | 1.13 | 1.09 | 1.07 | 1.05 | 0.99 |
| | Relative | 100 | 96.2 | 95 | 92.5 | 87.5 |

It should be pointed out that greatest benefits physically from organic matter applications usually occur relatively soon after application, i.e. within the first 12 to 18 months. After that period the favorable effects gradually diminish, which means that sludge applications need to be made probably every three to five years.

Also our work indicates that greater benefits are likely to accrue to lighter soils such as sandy loams than to loams and silt loams. Although we have not worked with clay loams and clays, it is presumed that they would be appreciably benefited by sludge, chiefly in making them more porous and better aerated.

There is another use for sludge—making topsoil out of natural subsoil—a practical solution to topsoil loss where it has been removed by erosion or by sale of balled plants in commercial nurseries. The New York City Park Department employs digested sewage sludge in the preparation of artificial topsoil for use in the city parks.

### Conclusions

From these findings it is concluded that digested sewage sludge as produced in Connecticut treatment plants is markedly beneficial to our soils and, when used under proper conditions, it improves crop yields. Our research has shown that: (a) growth of small grains and grasses was generally increased irrespective of the soil pH; (b) crops like beets and spinach are benefited only where the soil is adequately limed (pH 6.5 or higher); (c) coniferous nursery stock is probably benefited by moderate rates of sludge (50 cu. yds.) provided the soil acidity is maintained at about pH 5.3 — 5.8.

On strongly acid soils, sludge applied at rates approximating 50 cu. yds. per acre was found to be deleterious to most agricultural crops (except grasses and small grains) as the result of minor element toxicity. Very high applications, approaching 150-250 cu. yds., may be disastrous unless the soil is well limed.

Some sludges tend to delay germination, particularly at the higher rates of application, and especially where the sludge is fresh from the treatment plant. In field practice moderate applications applied some months before seeding would presumably not create this problem.

### Acknowledgement

The author wishes to acknowledge contributions made to these studies by John P. Hollis, Frances Meyer, W. T. Mathis, D. B. Downs, and Ruth Galinat.

*The ability of a soil to hold and exchange bases, chiefly calcium, potassium and magnesium.

## Research Project on Flax Cooking Wastes

A research project has been started at the Lawrence Experiment Station of the Mass. Dept. of Public Health to study paper mill wastes resulting from the cooking of flax, raw cotton, rags and used rope. Emphasis will be placed on the study of flax cooking wastes as the discharge of these wastes constitutes a source of pollution to the Housatonic River in Massachusetts.

An early experiment in this field at the Experiment Station produced biological procedures that appeared encouraging and experiments conducted by the National Council for Stream Improvement at about the same time revealed similar results. The present studies would utilize biological, chemical and physical processes to find the most reasonably available and economical method for treating these wastes.

# 1953 Conference of A.W.W.A. in Grand Rapids, Mich.

Second Report—Important Technical Sessions

OUR first report of the 73rd annual meeting of the A.W.W.A. (June issue) described highlights of the conference in Grand Rapids, May 10-15, and reviewed sessions of the purification division.

In this issue, we report the papers presented in the well-attended General Session on Fluoridation; three sessions of the Water Works Management Division, and a Joint Session of the Resources and Purification Division.

## Fluoridation Session

A capacity audience at the one session held on the last day of the conference demonstrated that there is an unabated interest in the subject of water fluoridation. The papers comprising this program covered widely different aspects of the subject: evaluation of naturally occurring fluorides, defluoridation methods, milk as a potential fluoride carrier, and the health aspects of fluoridation.

### Nature's Demonstration of Fluoridation

"AN EVALUATION OF FLUORIDES IN NORTH DAKOTA WATER SUPPLIES" was reported in a paper prepared by Arthur E. Williamson, Div. of Municipal Engineering, and Jerome H. Svore, Chief San. Engr., Environmental Sanitation Service, State Dept. of Health, Bismarck, N.D. Mr. Williamson presented the paper.

Rough data published in 1951 indicated the basic relationship between naturally occurring fluorides in North Dakota water supplies and the DMF rates of children. These data also suggested the influence of climatic conditions, and were offered to answer questions for residents of the state. They served to stir up considerable interest.

A new and more comprehensive survey has been made to provide more accurate data. The U.S.P.H.S. aided to make the information obtained more precise. This survey was concentrated on ten communities; it included 3,220 school children, aged 6 to 14 years, and was limited to only those born and raised in the community. (Not more than 20 per cent of children in the age group met the last qualification.) The fluoride concentrations involved ranged from low (up to 0.2 ppm), to medium (0.5 ppm), and high (2.3 ppm).

In the new survey, a definite relation is demonstrated between the concentration of fluorides and the rate of dental decay. The data show the relation to be a straight line function up to a fluoride concentration of 1.5 ppm. Mr. Williamson used excellent color slides to illustrate degrees of fluorosis found in the study. The publication of all the details evaluated will constitute a valuable record.

### Removal of Fluorides from Water Supplies

"DEFLUORIDATION OF MUNICIPAL WATER SUPPLIES" was described by Franz J. Maier, San. Engr., Div. of Dental Public Health, U.S. Public Health Service, Bethesda, Md.

There are only five municipal plants in operation for *removal* of fluorides from water supplies—this, in spite of the fact that about 500 communities (having a population of more than 1 million) use water containing above 1.5 ppm fluoride. The reason is that a simple method using standard water processing equipment is needed; obviously local operators in small communities cannot be technical experts.

In order to compare available processes, operation, and costs as a basis for action by other communities this study was made. The town of Bartlett, Texas, was selected as the site: its water supply has a fluoride ion content of 8.0 ppm, a total solids content of 2,000 ppm, and a hardness of 175 ppm; the population is 1800.

The possible processes for removing fluorides were narrowed down to four, all regeneratable:

1. Synthetic calcium apatite. Cost of this estimated to be $50 to $60 per mg. (Based on three months use at Britton, N.D., where the process was subsequently replaced by the use of bone char).

2. Amberlite resins 4B and XE75 (produced by Rohm and Hass Co.). Treatment by this material was estimated to cost $200 per mg.

3. Magnesium compounds effective in lime softening. (About 35 to 65 ppm of magnesium must be removed per 1 ppm of lime, in order to remove fluoride.) At Bartlett, this process would require about 10 tons of lime per mg of water treated.

4. Aluminum compounds used for coagulation. This process, using dehydrated aluminum oxide, was installed for automatic treatment of water pumped from two wells. Equipment included a contact tank, a caustic soda tank, and a sulfuric acid tank.

Each regenerating cycle required the use of 500 lb. of new 1% caustic solution and 140 lb. of caustic soda saved from the previous regeneration. A regenerating cycle was needed each 3 days in summer and each week in winter. Operation of this plant, started in March 1952, has demonstrated that a fluoride content

Jack E. McKee
Prof. of San. Eng.
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Pasadena, Calif.

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Lansing, Mich.

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San. Engr.
U. S. P. H. S.
Bethesda, Md.

Jerome H. Svore
Chief San. Engr.
State Health Dept.
Bismarck, N. D.

**Fluoridation Session Programmers**

of 8.0 ppm in the raw water can be reduced to 1.0 ppm. Installed cost of the automatic defluoridating unit, about $7,000; operating cost of the unit is about $52 per mg.

### Another Fluoride Carrier?

"A Rational Approach to Fluoridation" is the title of a paper by Jack E. McKee, Assoc. Prof. of San. Eng., California Institute of Technology, Pasadena, Calif. The paper was published under the same title in the April, 1953, issue of the A.W.W.A. Journal.

Professor McKee reviewed fundamental facts regarding the benefit (carioustatic effect) of a fluoride intake of 1 mgm per day, and analyzed advantages and disadvantages of various carriers of this trace element. He pointed out what he considers the advantages of using fluoridated milk for the purpose.

To utilize milk for the purpose, not only would a change in the present pure food and drug laws be required, but further research would be necessary. That recommended by Prof. McKee includes: study of the merits of milk as a carrier; the control tests required; and surveys to determine which communities might be better served by fluoridated milk supplies.

### Fluoridation and Health

"How a Health Commissioner Looks at Fluoridation" was described by A. E. Heustis, Commr., Michigan Dept. of Health, Lansing, Mich. His clear and comprehensive review of the subject provides a useful reference and sane point of view—all who can use such material will find it a valuable presentation.

After reviewing the background of water fluoridation, the author cited results of the Grand Rapids demonstration — where eight-year-old children, who have received artificially fluoridated water all their lives, show a reduced dental decay rate; the rate is the same as that in Aurora, Ill., which has a water supply naturally containing 1.0 ppm fluoride ion. The same trends are shown for every community having an experimental study of fluoridation.

This procedure, he said, is legally applicable, inexpensively suitable for mass control of a universal disease, and provides a real opportunity for statesmanship in public health. Fluoridation treatment *is* a benefit which goes beyond the traditional job of providing water adequate in volume and free from water-borne disease.

He carefully analyzed arguments against the adoption of water fluoridation: Dental caries is clearly a deficiency disease. First nature, and now

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man, demonstrated that water containing 1.0 ppm of fluoride ion provides about 65 per cent reduction in the disease. (This requires adding 20 lb. of chemical per mg—and to make a consumer ill, its addition at a 4-ton rate would be necessary.) The treatment is far less costly than any other possible means. As a result, the policy of the Michigan Dept. of Health is to strongly recommend the fluoridation of public water supplies.

Benjamin C. Nesin, Dir. of Labs., Dept. of Water Supply, New York, N.Y., commented with reference to Prof. McKee's paper and cited some statistics applying to New York City. The fluoridation of the water supply of this city presents a rather special case: 55 to 60 separate installations would be required at an initial installation cost he estimated to be $3 million; the daily application of up to 15 tons of fluoride chemical would be needed. By contrast, he said that the milk supply of the city is processed in only 37 plants, where fluoridation might be practiced at an initial cost estimated to be $350 thousand (this would be a batch operation).

## Management Division

The Water Works Management Division held three sessions, the first being devoted largely to problems of water supply beyond city limits.

### Supplying Water to Suburbs

"Meeting the Needs of Fringe Developments" were described in a paper by Frederick Wegner, Adm. Asst., Office of City Mgr., Grand Rapids, Mich.

In describing the Grand Rapids Urban Service Plan, Mr. Wegner indicated that historically the city favored the selling of water at wholesale rates at the city limits to suburban users. When the Lake Michigan supply was available about 1950, the city not only changed the policy and billed customers direct, but took over individually owned meters and the service lines. The city considers cast iron pipe as basic design and requires suburban areas to replace small or steel lines at their own expense. If the lines are of standard size, Grand Rapids will probably have to replace them at the city's expense.

About 1950 it was realized that the water system must be enlarged to serve the surrounding suburban areas, so rates were first set at 110 per cent of city rates and later 160 per cent of inside city rates. This was done in spite of 30-year contracts at the lower schedule, by virtue of a clause in the city charter which prohibits the city from having contracts of more than 3-year duration. However, the city will not extend water service except on a long time and permanent basis. The Urban Service plan is most economical when 15 miles of service mains will serve 6,000 people per square mile of suburban area.

The city has established a fixed perimeter about the city which it will serve regardless of whether the area is incorporated or unincorporated. Annexation is not necessary as the area within the perimeter is zoned and water, sewer, public health measures, etc. are applied. As yet there is no City-County Health Department, and the extension of public health protection in the city to the areas within the perimeter is a good lever.

A policy of "no extension until services are ample to cover expenses" is followed and the suburban areas pay cash for the extension. Design policy requires 6" cast iron minimum size mains with 12" on quarter section lines. Inside the city the 6" mains are paid for by special assessments; if a 12" main is necessary, the city pays the extra cost over a 6" line. All construction is by competitive bidding on plans prepared by the city engineer, except that short extensions under 250 feet in length are laid by

*This session was reported by E. L. Filby, Cons. Engr., Black & Veatch, Kansas City, Mo.

**Management Programmers**

**Inter-City Supply**
Alfred Eckert
Mgr. Water Board
Saginaw-Midland
Saginaw, Mich.

**Main Extensions**
Lewis S. Finch
V. P. & Chief Engr.
Ind. Water Co.
Indianapolis, Ind.

**Water Rates**
J. R. Pierce
V. P. & Genl. Mgr.
Gen. Waterworks Corp.
Pine Bluff, Ark.

**Air Conditioning**
Frank C. Amsbary
Vice-Pres. & Secy.
Ill. Water Serv. Co.
Champaign, Ill.

**Water Rates**
Louis E. Ayres
Cons. Engr., Ayres,
Lewis, Norris & May
Ann Arbor, Mich.

city water department crews. Cost is $3.50 per foot for first 60 feet and $3.00 for next 190 feet. City makes the water tap and checks residence plumbing.

Urban areas take about 10 per cent of the average 30 mgd load. Peak use is about 63 mgd, but the pipe line from Lake Michigan can only deliver about 59 mgd and the filter plant can process about 50 mgd. If urban areas adhere to the present plan, increased supply and processing can be provided.

That this subject is of wide present concern was indicated by questions asked in the discussion period following Mr. Wegner's paper.

*Question.* What is city liability or responsibility to furnish water at all times to outlying areas?

*Answer.* Inside and outside areas are so closely bound together by economic and health factors that no discrimination can be applied. All are equally served.

*Question.* Does the Urban Service Plan reduce the chances of the city annexing suburban territory?

*Answer.* City policy is not to expand, and only if it is mutually agreeable with both parties, annexation will proceed. Annexation is not generally considered a good plan.

*Question.* As the water plant is adequate only for inside the city requirements, and serving outside areas make expansion necessary, does the 160 per cent rate take care of such costs?

*Answer.* The 160 per cent rate contemplates that the urban service areas and the city will each pay their just share.

*Question.* The 6" minimum pipe line and 12" size in quarter section lines, etc., are financed by assessment on 6" basis: how does the city get funds for the larger sized mains?

*Answer.* All water works revenues are left in a separate fund and the department stands on own feet. It is possible however to transfer any surplus to the city's general fund.

*Question.* Is there any arrangement to refund the investment of a suburban area after it is annexed?

*Answer.* No refunds are possible. The annexed area would of course get city rates.

*Question.* If major extensions inside the city are required to meet outside demands, how are these paid for?

*Answer.* Paid for out of water works funds.

*Question.* Do you sell to any private corporations or companies outside the city?

*Answer.* No, only to incorporated or unincorporated areas.

*Question.* How about rates—water and sewer?

*Answer.* Sewage disposal charges put in last fall are independent rates based upon a factor of water consumption. Rates are too complicated for answer from platform.

## Main Extension Policy

"Water Main Extensions — A Committee Report" was presented by Lewis S. Finch, V.P. and Chief Engr., Indianapolis Water Co. (Chairman of Committee A3.D on Water Main Extension Policy).

Mr. Finch gave the 1953 progress report of his committee in a very voluminous report. There is apparently no conformity of policy as to suburban area main extension but the National Association of Railroad Utilities Commissions are working on a report. In some states the utility commission has jurisdiction over service and rates beyond the city limits, in other states they do not.

Management should recognize that the State Public Service Commission may have jurisdiction beyond the city limits. Rates should be such as to earn a profit for a municipality the same as for a privately owned corporation, and the rates may be subject to state regulation outside the city if not inside the city. The collection of fire protection charges in suburban areas may be difficult unless a fire protection district is established and has the power of taxation. Main extension principles should be the same — inside or out — the installation should be self-supporting.

Policies of financing main extensions outside the city vary widely—such as the area paying the entire cost, as at Grand Rapids, to refunding of cost as areas develop. Any extension should be based on a revenue basis and not on feet of pipe per customer connected. Cost of main is but one part of costs involved. The equity of "free riders" who subsequently connect to an extension is questionable.

*Question.* How do you propose to control design standards in fringe areas?

*Answer.* Grand Rapids has shown how they do it and if it is explained that a 2" pipe costs almost as much as a 6" main in a grid system, and that the 6" main gives fire protection as well as domestic water supply, the 6" can be sold to developers.

## Inter-City Water Supply

"Management and Operation of the Saginaw-Midland Supply Line" were described in a paper presented by Alfred Eckert, Mgr. Board of Water Commrs., Saginaw-Midland Water Supply System, Saginaw, Mich.

Mr. Eckert reviewed data presented in his paper which was published in the February, 1949, issue of the A.W.W.A. Journal. He added that in the past four years only three pipes have needed repairs, only one joint required repair after test; otherwise the pipe line has operated perfectly and everybody is happy with the installation.

## Water for Air Conditioning

"Water Use in Air Conditioning" was introduced by Frank C. Amsbary, Vice-Pres. & Secy., Illinois Water Service Co., Champaign, Ill., as chairman of the association's Committee on Water Use in Air Conditioning.

M. B. Cunningham
Supt. & Engr.
Water Dept.
Oklahoma City, Okla.

W. Victor Weir
President
County Water Co.
St. Louis, Mo.

Louis R. Howson
Cons. Engr.
Alvord Burdick, Howson
Chicago, Ill.

John H. Murdoch
V. P. & Counsel
Am. W. W. Service Co.
Philadelphia, Pa.

Samuel B. Morris, Genl.
Mgr. & Chief Engr.
Water Dept.
Los Angeles, Calif.

**Management Can Promote Better Public Understanding**

The model ordinance for the control of water use for air-conditioning which was offered by the committee in 1950 was highlighted, with emphasis being placed on the recommendation that a demand charge be established as a means of encouraging use of water conservation units by customers operating air cooling systems. Reference was made to the Kansas City pattern of employing the demand charge system for water users who place a peak load on the water system for air cooling or any other temporary or seasonal water use.

The committee feels that as long as the supply is adequate and the system is capable of standing the peak demand without expensive amplification, pressure on customers to make use of water conservation units would prove to be insupportable.

"Demand Charge for Air Cooling Water as a Practical Solution," was presented in an unscheduled paper by J. R. Pierce, Vice-Pres. and Genl. Mgr., General Water Works Corp., Pine Bluff, Ark. In the author's absence his paper was read by Elwood L. Bean, 1st Asst. Engr., Bureau of Water, Philadelphia, as a member of the Committee on Water Use in Air Conditioning.

Mr. Pierce's paper is printed in full in this issue. In brief an application was made to the Arkansas Public Service Commission for approval of a special demand charge to customers using water for air cooling without benefit of recirculating water conservation equipment. Data which was assembled formed the basis for the demand charge applied for. The Commission allowed the extra service charge of $2.50 per ton of refrigeration capacity per month for the months of May through September. Customers with refrigeration capacities in excess of three tons per day, without water conservation recirculatory systems are now billed by authorization of the Commission.

M. P. Hatcher, Director of Water, Kansas City, Mo., stated that since the Kansas City Demand Charge had been referred to he should report that the original demand charge had been found inadequate. Upon careful analysis a demand charge of $16.00 per month per ton of refrigeration capacity seemed to be the proper charge to customers operating non-conserving cooling systems. By the same method Kansas City, Kan., had arrived at $15.00 monthly as the proper demand charge during four months of air cooling.

### Water Rates

"Water Rates" was the subject of another committee report by L. E. Ayers of Lewis, Norris and May, Engineers, Ann Arbor, Mich., as chairman of the association's Committee on Water Rates.

Mr. Ayers reported that his committee of 13 members had finally come to an agreement on at least the basic concepts in rate making for water service. The report now contains recommendations covering basic rules, patterns and alternates. For privately owned systems the Utility Base would apply, whereas for municipally owned systems the Cash or Budget Base would apply.

Costs of supplying water service consist of normal customer service to which is added Peak Demand Service and Functional Service.

Charges must consist of a Service Charge (Minimum Bill); Commodity Charge (Rates); Special (Demand) Charges. To pay costs of fire protection funds should come from the tax payers and will amount to more than half the total cost. In discussing Special Services such as water for air cooling and sprinkling the committee finds that on maximum water use days 25% goes into air cooling, 25% into sprinkling; 50% for normal requirements. To meet these peak loads the committee finds an expansion of distribution storage the most economical solution rather than larger mains or multiple mains and increased pumping capacities.

Consideration of a proper Special Service (Demand) Charge for air cooling customers the committee believes that $12.00 per month per ton of refrigeration capacity will constitute the average fair Demand Charge to customers who have not provided water conserving recirculatory systems.

As to costs for adequate fire protection service the pattern is far different from the figures to be found in the often quoted historical documents of 1911. Again, to hold down cost of fire service more distributed storage is indicated in preference to larger or multiple mains and increased pumping capacities.

*Question:* What recommendation does the committee make concerning rates in suburban areas where fire protection capacity of extension is also supplied?

*Answer:* The committee believes that there is but one sound answer: namely, rates which will cover *all* costs, including interest, amortization, etc. without regard to type of ownership of the system.

### Advancing Public Appreciation of Worth of Water Service

A panel discussion of ways and means of promoting a better understanding on the part of the public to the true worth of water supply service was conducted under the leadership of President Cunningham, supported by past-presidents Victor Weir, Louis Howson and Saml. Morris plus John Murdoch, long-time president of the Pennsylvania Water Works Assn.

W. Victor Weir, Pres. & Genl. Mgr., St. Louis County Water Co., pointed out the very narrow margin which is to be found between the cost of supplying good service and that of supplying poor service. Often times a minor rate increase can change poor service to good service and effective expansion of the system.

**Management Programmers**

**Safe Industry**
Raymond J. Faust
Exec. Asst. Secy.
A. W. W. A.
New York, N. Y.

**Safe Treatment**
Oscar Gullans
Chief Filt. Chemist
Sou. Dist. Plant
Chicago, Ill.

Above all else it is the duty of the water utility (public or private) to keep the people informed concerning its operation, service rendered, improvements needed, financial status, need for keeping operations in the black, better compensation for key men lured by industry paying higher salaries.

A comparison of what it would cost the average consumer to provide his own well, pump, tank, power and maintenance, as against his water service billings is perhaps the most effective way of convincing the water taker of the worth of public water supply service. Add to this the fact that his fire protection couldn't be duplicated in a privately owned system, nor could he obtain the low fire insurance rates enjoyed as the result of dependable fire supply service.

Answering the question "Who is responsible for keeping the water utility in a satisfactory financial condition, which in turn means good service?", Mr. Weir stated that the local manager has this responsibility. In fact it is the most important job that he has. In this effort he can call on the A.W.W.A. for assistance in providing plans to follow, arguments to use in presenting the case for the water utility to the City Council and other bodies.

In short, Mr. Weir placed the responsibility of procurement of rates adequate to provide the all-necessary funds to support good service squarely up to the local superintendent or manager. With good service and a well maintained system the public is not difficult to sell on the worth of the local water supply service.

Louis R. Howson, of Alvord, Burdick & Howson, Engrs., Chicago, said that the public little appreciated the fact that they are in reality "stockholders" in a publicly owned water system and if the system is permitted to deteriorate as the result of selling its product at less than cost of production they as "stockholders" are obliged to suffer in the long run. Sometimes as little increase in rates as one-half cent will spell the difference between procurement of good service and mediocre service.

Experience reveals that it is not difficult to sell the public on increased rates for improved water quality—water softening, iron removal, a better tasting water, all being cases at point. The same applies in respect to increased pressures in the homes, or more water to permit lawn sprinkling at will.

The value of maintaining a close contact of water utility management with municipal officials was stressed by Mr. Howson. And, he had found close contact with civic organizations the best approach to the procurement of more adequate rates.

Samuel B. Morris, Genl. Mgr. and Chief Engr., Dept. of Water & Power, Los Angeles, said that unless the people are constantly kept informed concerning the local water supply situation appreciation of water is quickly lost. Los Angeles believes this to the extent of employing a public relations expert and employs an advertising agency to supervise the Department's newspaper advertising. The expenditure involved is almost $500,000 annually, $60,000 going for newspaper advertising.

Mr. Morris used lantern slides to show a series of newspaper ads and other publicity pieces. At present Los Angeles has a program of water supply improvements which will run to $73,000,000 whereas at one time it was thought that the water problem of Los Angeles had been solved for all time to come.

John H. Murdoch, Vice-Pres. & Counsel, Am. Water Works Service Co., Philadelphia, stated that the water supply industry had at one time boasted the cheapness of water service and this curse still afflicted the industry. Water works managers should use every means of showing the public how improved service can be obtained if net income permitted.

Mr. Murdoch deplored the psychology of too many water works managers who were ready to explain poor service on account of a debilitated system rather than going to the mat for money to improve the system. Many were actually afraid to recommend increasing rates. Some thought and acted like managers of bankrupt bargain basements.

Mr. Murdoch closed with the thought that the A.W.W.A., having done much for the technical advancement of the water supply industry, might turn its attention to a long term project looking toward the establishment of some sort of system for the objective grading of physical and economic efficiencies of water utilities so that there could be *ideals* toward which to work in water supply operations. At the same time studies might well develop measures most suitable to the financing of water supply improvements in the smaller communities in particular.

## Drought Conditions*

"The 1952 Drought in the Southwest—Its Supply and Public Relations Problems" by Marvin Nichols, Freese & Nichols, Cons. Engrs., Fort Worth, Texas, was a scheduled paper for the final session of the Management Division. A change in program resulted in Mr. M. B. Cunningham, Supt. and Engr., Water Department, Oklahoma, reporting on a study made of drought conditions in Oklahoma.

Drought often causes water works management to re-examine the adequacy of water supply. In many locations, several inches of rainfall are required to produce run-off which will assist surface water supplies to any great extent.

Population increases contribute substantially to making drought periods increasingly critical. State wide studies as well as regional studies of watershed areas are made with a view to long range planning. Conservation of soil and timber resources receive close attention as factors influencing adequate surface water supplies.

Municipalities make extensive surveys in arranging for water supplies, with increases in per capita consumption often contributing alterations to carefully laid long range plans. For example, Oklahoma City's Lake Hefner raw water storage reservoir met 103 per cent of its estimated 1975 demand during 1952.

Past experience dictates that management must adjust storage capacities to cover from three to ten years' supply, depending on annual rainfall. Protection of the watershed against taste and odor producing compounds is often necessary. Interstate compacts assist greatly in protection of one state's water resources against pollution by wastes from a neighboring state. Oil well brine is a major problem which requires constant surveillance for effective control. Methods for chloride removal, however, have contributed markedly to the use of waters formerly rejected due to high chloride content.

With respect to water works management and public relations, Mr. Cunningham indicated that wide pub-

*This session was reported by V. M. Langworthy, Research Chemist, The Chlorine Institute, Inc., New York, N.Y.

licity should begin with consulting engineers' reports, especially where bond issues are marketed. Local means of public information may be used to good advantage in relaying management problems to the citizenry. Meetings may be held at which employees may be advised of basic plans and of such changes as are proposed.

### Safety Symposium

"A Safety Program for the Water Works Industry," a symposium, was introduced by R. J. Faust, Executive Asst. Sec'y, A.W.W.A., New York, N.Y., who reported that the water works industry is not safety conscious, since it ranks thirty-third in terms of frequency rate and equals the national average in all industries for accident severity. This record can definitely be improved, and the American Water Works Association has established a task group to investigate safety from the standpoint of Water Supply, Treatment and Pumping, Distribution and Administration.

The selling of safety involves no product; however, safety must be sold and practiced. Good safety practices will return dividends in the form of less lost time due to injury and possible reduction of insurance rates. A successful safety program depends on management and supervisory personnel being sold on safety, plus maintenance of complete safety records.

A report on safety in Water Supply, prepared by Jerome Powers, Div. Mgr., American Water Works Service Co., Richmond, Ind., was read by Dale Maffitt, Gen. Mgr., Board of Water Works Trustees, Des Moines, Iowa. Hazards in maintaining water supply facilities are similar to those encountered in construction activity.

With regard to watershed properties, surveying, mapping, forestry, swamp drainage, ditching and fencing are examples where safety needs must be recognized. Water supply reservoirs present opportunities to encourage safe practice in fencing, lighting, boating, ice fishing and debris removal. Structures, pumps and related equipment, as well as dams and intakes, are sources of possible accident.

Oscar Gullans, Chief Filtration Chemist, South District Filtration Plant, Chicago, Ill., reported on the operations of a safety committee at the South District Plant. Members of the committee represent all employee groups and serve three month terms. Safety practices are established for each department and meetings are held to discuss accident causes and suggestions for corrective action. The meetings are repeated to enable shift employees to attend.

As a result of this procedure, the safety record at the South District filtration plant has had a drop in severity rate from 0.611 in 1949 to 0.044 in 1952. Large plants present difficulty in attempting to eliminate items which need correction, often to the extent that new ways of doing jobs must be found. Mr. Gullans suggested three steps to accomplish a firm advance against accidents:

1. Eliminate hazards.
2. Locate possible sources of hazards.
3. Follow up to prevent accidents.

K. A. Day, Safety Officer, Dept. of Water Supply, Detroit, Mich., reported on activities of the group assigned to study safety in the distribution system. A survey questionnaire, designed to cover a three-year period, was distributed and results tabulated.

The survey revealed that most injuries among distribution system employees are received from elemental hand tools. Ranking second was injury resulting from lifting, and the third highest number involved working surfaces (slippery footing). Pushing, pulling or striking were revealed as the most prominent circumstances leading to accidents, while types of accidents included falling, sliding, being struck by flying objects and falling against an object.

Among the features of safety programs, supervisory training was shown to be most prominent in the distribution departments surveyed. Other factors included: Continuing interest of administrative officials, machine guards, good housekeeping and careful selection and placement of workers.

Mr. Day also reported motion pictures, driver training and further training of field supervisors are items needed in progressive safety programs.

A brief report on safety in Administration was presented by Martin Flentje, Research Engineer, American Water Works Service Co., Philadelphia, Pa. High on the accident list among administrative department personnel are the meter readers. Their occupation is hazardous from running, falling, slipping and dog bites!

Office workers are exposed to hazards from stumbles, slips and pencil points—however, accident frequency and severity rates are very low, indicating there are fewer hazards and less severe accidents among office workers.

**Resources and Purification Session**

**Irrigation and Water Supplies**

Paul D. Haney
San. Engr. Dir.
U. S. P. H. S.
Cincinnati, O.

J. K. G. Silvey
Chmn. Science Div.
N. Texas State Col.
Denton, Texas

## Resources and Purification Joint Session

Three papers were presented in a joint session of the Resources and Purification Divisions, all relating to aspects of raw water pollution.

### Irrigation Runoff

"Effect of Irrigation Runoff on Surface Water Supplies" was the subject considered in a panel discussion, with Morrison B. Cunningham, incoming President of the A.W.W.A., serving as moderator.

In introducing this subject, Mr. Cunningham called attention to its importance in connection with the multiple use of water resources. He mentioned the mineral concentration increase in return irrigation flows, and pointed out how loss of about two thirds of the water by evaporation and transpiration would result in a three-fold increase in the concentration of dissolved minerals such as chloride, sulfate and hardness producing constituents.

Cunningham emphasized that the purpose of this discussion was to focus attention on a subject not previously considered by water works men. He then introduced the various panel members.

Paul D. Haney, Sanitary Engineer, Environmental Health Center, U.S. Public Health Service, opened the discussion.

The water works profession's interest in irrigation stems from the facts that irrigation is one of the largest users of fresh water and that drainage from irrigated areas may have important effects on water quality. Consumptive use, that is, evaporation and transpiration, accounts for roughly two-thirds of all the irrigation water used. Irrigation use amounts to about 90 billion gallons of water daily.

The object of irrigation drainage is not only to remove surplus water

*This session was reported by Paul D. Haney, San. Engr., U.S.P.H.S., Cincinnati, Ohio.

**Resources and Purification Session**

**Industrial Pollution**
Frank DeHooge
Supt. of Filt.
Passaic Water Comm.
Little Falls, N. J.

**Detergent Pollution**
Russell L. Culp
Chief, Water Supply
State Bd. of Health
Lawrence, Kan.

but also to remove from the irrigated area approximately as much harmful mineral matter as is brought in by the water applied to the land. On the average about one-third of the water diverted for irrigation appears again in the stream as drainage or "return flow."

Considerable variations in the effects of irrigation return flow or water quality are to be expected but general trends may be predicted from consideration of what happens when irrigation water is applied to land. Little of the mineral content of the water is taken up by the plants; consequently, as evaporation and transpiration occur there is appreciable concentration of the salts. Most of the original mineral matter is now contained in a much smaller volume of return flow. Repeated use of the waters of a stream for irrigation results in repeated salt concentration. Thus, leaching of arid soils, which usually contain more soluble matter than soils in humid regions, can result in considerable mineral gain in receiving streams.

Streams generally show increased mineralization between headwaters and mouth but the general tendency in a stream as the water is used and reused for irrigation is in the direction of fairly large increases in total dissolved mineral solids with attendant increases in hardness, chloride, and sulfate. The percentage composition of the dissolved mineral matter also changes significantly with a decrease in the percentage of calcium and an increase in sodium.

Increase in total solids and per cent sodium makes the water less desirable for irrigation and other uses. Too high a proportion of sodium in an irrigation water has adverse effects on the soil. This has led to the saying that "Hard water makes soft land and soft water makes hard land."

Disposal of the burden of residual salts from irrigation projects in such a way that receiving water quality will not be unreasonably impaired is one of the many problems associated with multiple use of water resources. Probably there will be more concern with this problem in the future than there has been in the past. Irrigation farmers as well as water works men and others are interested in this problem. The quality requirements of irrigation water are just as exacting in some respects as those for public water supply or industrial use.

CHARLES S. HOWARD, Regional Chemist, Quality of Water Branch, U.S. Geological Survey, Salt Lake City, Utah, was the next speaker. Data relating to the mineralization of streams by return irrigation water were effectively presented by means of numerous colored slides. It was emphasized that irrigation drainage waters need dilution just as in the case of other types of wastes. However, the possibility of dilution becomes less as the water is consumed by repeated irrigation use.

Recent studies have shown that large quantities of dissolved salts are brought into the Yakima River in Washington as a result of irrigation. Large irrigation developments in the San Joaquin Basin in California use water from the San Joaquin River and some from the Sacramento River. Analytical results for the San Joaquin show considerable changes in the water quality with the concentration of dissolved solids increasing downstream.

Records show that the concentration of dissolved solids of the Rio Grande at Fort Quatman, Texas, is more than 16 times the concentration of dissolved solids in the river about 90 miles below the Colorado-New Mexico state line. In some areas along the Colorado River signs of accumulation of soluble salts because of poor drainage are visible and some tributaries bring in waters of relatively high concentration which are of no value for the dilution of drainage waters. Storage at Lake Mead not only regulates the flow of water but also regulates water quality. Storage has decreased the range in concentration of dissolved solids of the water in the lower Colorado River.

The possible effect on water quality through irrigation practices often has not been recognized. There are few legal documents that mention water quality but it is likely that discussion leading up to the preparation of river compacts may have considered the effects of irrigation practices on water quality. Extensive use of insecticides, herbicides and fertilizers present new unknowns as far as water quality is concerned.

DR. J. K. G. SILVEY, Chairman, Division of Science, North Texas State College, Denton, Texas, was the final panel speaker. He discussed taste and odor problems associated with irrigation water use, in a presentation using a colored film with Dr. Silvey serving as the sound track. The discussion dealt with the conditions created by irrigation that cause the productions of taste and odor in water, and the nature of the organisms producing taste and odor.

Minerals are essential to the growth of plants that support taste and odor producing organisms in the water. Other conditions being equal, the greater the concentration of nutrient materials (toward the optimum amount) the more extensive the growth of these supporting plants. Phosphorus and nitrogen are two of the elements that appear to act as limiting factors on the growth of aquatic organisms. The nitrogen concentration necessary is about 0.3 ppm and the phosphorus content about .015 ppm. From observations and studies of samples of water from the Rio Grande Valley of Texas, it is evident that phosphorus as well as nitrogen is available in the runoff flows from irrigated land, thus increasing the amount of available fertilizing materials above the amount found in streams not used for irrigation.

The whole question of the influence of irrigation practices on water quality is of interest to the city of Oklahoma City where an irrigation project has been proposed which would utilize the waters of Canton Reservoir. This reservoir is located on the North Canadian River about 100 miles above Oklahoma City.

The most common cause of taste and odor is neither contributed directly by algae, higher plants nor animals but by organisms known as *actinomycetes* which grow on or in the living algae, plants, and remains of dead animals. In the Southwest, rivers and reservoirs may contain taste and odor producing compounds but few if any algal organisms may be collected. On the other hand lakes, reservoirs, and rivers have demonstrated prolific concentrations of algae with no apparent occurrence of tastes and odors.

A hypothesis concerning the association of actinomycetes with certain genera of algae has been developed. The actinomycetes living on the interior of algal cells exist in an imperfect symbiotic condition with the algae. As long as the algae obtain ample quantities of nutrients this association persists. When the plants lose their ability to increase or sustain themselves the actinomycetes alter their association from a symbiotic relationship to a saprophytic or

parasitic condition. This results in a rather rapid destruction of the plants, with a concurrent liberation of the by-products of the metabolic activity of the actinomycetes. These metabolic by-products are essentially the substances that give rise to tastes and odors in water. The by-products produced by the actinomycetes under symbiotic conditions are different from those by-products produced in the plants that are in the process of deterioration.

### Industrial Wastes

"Controlling Industrial Pollution of the Passaic River" was the title of a comprehensive paper presented by Frank J. DeHooge, Purification Supervisor and Chief Watershed Inspector, Passaic Valley Water Comm., Little Falls, N.J.

This commission was set up and is owned by the cities of Paterson, Passaic, and Clifton; it supplies water to a population of about 400,000 in the highly industrialized metropolitan area of Northern New Jersey. It has rights to divert 75 mgd from the Passaic River and 41 mgd from the Wanaque Reservoir. The Passaic River drainage area includes more than 300 industrial plants, and 23 municipal and institutional sewage treatment plants—thus the pollution load could become intolerable if strict controls were not exercised.

There is no impounding reservoir and the river flow varies 50 mgd to more than 10,000 mgd. As a result of rapid increase in industries during World War II, the State Dept. of Health made sanitary surveys in 1942 and 1943. Based on these surveys, minimum water quality standards were adopted by the Commission. These provided, essentially, that waste effluents shall have a pH value between 4.1 and 8.3, and shall be "relatively" free from bacteria, B.O.D., turbidity, taste, odor, and color.

Mr. DeHooge told the story of how a 50-year-old treatment plant (modernized and maintained in up-to-date condition) can handle any raw water condition—when aided by an effective stream pollution control program. The basic jobs of the program are: first, find the polluter; second, persuade or force him to correct "the mess he has made"; and, third, by means of eternal vigilance, see that it stays corrected. He described the important part stream sampling and analysis play in the successful accomplishment of all these jobs, citing many specific examples to illustrate his points.

A good laboratory organization is a "prime requisite" for the success of a pollution control program. Laboratory records prove that the work of the last ten years has made an enormous improvement in the condition of the river. During the past year, the finished water from the treatment plant had an average color of 4.0 ppm, and not one of more than 5,200 portions tested showed the presence of coliform organisms. Coagulant requirement averaged only 21.7 ppm of alum, and 5.5 ppm of chlorine was the breakpoint dose required.

### Synthetic Detergent Problem

"The Effects of Synthetic Detergent Pollution on the Operation of a Public Water Supply Softening Plant" were reported in a paper by Russell L. Culp, Chief Water Supply Section, and Howard A. Stoltenberg, Chief Chemist, Division of Sanitation, Kansas State Board of Health, Lawrence, Kan.

Osawatomie, Kansas, a city of about 4500 population, obtains its water supply from the Marais des Cygnes River. The water is treated in a lime softening plant of conventional design. The plant has a capacity of 1.0 mgd and, although water demands are approaching design capacity, all raw water conditions previously encountered have been handled by the available facilities with a minimum of operating trouble.

Difficulties began in January, 1953 following a period of low stream flow. The raw water was clear (turbidity 10 ppm), highly colored (50 ppm) and had a very strong fishy taste and odor. Water temperature was near freezing. Using normal chemical dosages, 200 ppm of lime and 2 grains per gal. of alum, a large floc formed quickly but the settled water was cloudy. The coagulation and settling basins were covered with several inches of floating material and, in addition, there was considerable froth on the water surface in the coagulation basin.

J. C. Higgins, Supt. of Utilities, estimated that under the worst conditions about 70% of the coagulated material floated, 10% settled and 20% carried onto the filters. Rising gas bubbles were observed throughout the plant. Filter runs were reduced from 100 to 7 hours. The filtered water was colored, slightly cloudy, and had a strong, disagreeable fishy taste and faint odor. Discontinuance of softening increased the length of filter runs but other conditions remained the same.

An investigation at the Ottawa, Kansas, water treatment plant—located upstream—revealed normal operating conditions with no difficulties. A visit to the Ottawa sewage treatment plant yielded a hint as to the source of difficulty. Heavy froth was noted on the aeration tank and the operators of the plant reported that froth had also been observed in the river below the sewage plant outfall. Samples of effluent were analyzed for total anionic synthetic detergent by the improved methylene blue method (reported in *Sewage and Industrial Wastes*, January, 1953). Average results indicated 0.4 ppm in the river above Ottawa; 44 ppm in Ottawa raw sewage; 39 ppm in the Ottawa activated sludge treatment plant effluent; 4.5 ppm in the river just below Ottawa; 3.9 ppm in the Osawatomie raw water; and 3.6 ppm in the Osawatomie tap water.

Numerous tests were made at the Osawatomie water plant in an attempt to find methods for improving plant operation. Breakpoint chlorination proved effective at a dosage of 10 to 15 ppm of chlorine in color and taste removal. Activated carbon at dosages of about 40 ppm also successfully removed color, taste and odor. However, it was not practical to feed this quantity of carbon on a plant scale. Good coagulation results were obtained with alum and activated silica. A small dense floc which settled readily with little or no floating material resulted from the application of 1.5 grains per gallon of alum and 1 ppm of activated silica.

The plant was operated for several days applying 10 ppm of chlorine, 1.5 grains per gallon of alum and 1 ppm of activated silica. Complete color removal was obtained and while taste and odor of the finished water were greatly improved the taste was not entirely eliminated. Apparently the chlorine contact time on an operating scale was insufficient to produce results comparable to those obtained in the laboratory.

Arrangements were then made to feed chlorine dioxide to the filter influent at a dosage of 2 ppm. This eliminated the remaining taste and consumer complaints ceased in a few days. Later the chlorine dioxide application was reduced to 1 ppm with equally good results. Still later, when increased stream flow reduced the synthetic detergent content to 2.7 ppm in the river, it was found possible to discontinue chlorine dioxide treatment. However, the earlier difficulties could be reproduced at any time in the laboratory by adding 2 ppm of detergent to the raw water. From the data obtained it was established that the *minimum* synthetic detergent content of the Marais des Cygnes River water which would have an adverse effect on water treatment was 3.0 to 3.5 ppm.

# Stationary Bulk Storage of Liquid Chlorine

As a method of providing economical, convenient tank-car lot chlorine storage on customer's premises, could in many instances solve the vexatious chlorine shipping container problem

by A. S. WOODWARD, Chief, Central Eng. Dept., Pennsylvania Salt Mfg. Co., Philadelphia, Pa.;
and
L. L. HEDGEPETH,* Technical Consultant, Calco Div., Am. Cyanamid Co., Bound Brook, N.J.

THIS paper deals with the technical principles pertaining to the storage of liquid chlorine (liquefied, anhydrous, elemental chlorine) in permanently mounted stationary vessels at consumers' plants. It has been the practice to use chlorine shipping containers as storage vessels for consumer reserve supplies. Recently it has been suggested that an answer to one of the perplexing problems of chlorine reserves for water purification and sewage treatment plants might be found in utilizing stationary storage vessels.

This interest in stationary liquid-chlorine storage in bulk has resulted from a consideration of ways and means to insure an adequate reserve supply for public health purposes. During World War II, and for a hectic period following the outbreak of the Korean War, unprecedented shortages of chlorine developed in the United States, with the result that some water and sewage plants had temporary difficulty in securing sufficient quantities of chlorine. Managers of water and sewage works became gravely concerned and some *ad hoc* investigating committees were formed in late 1950. Relief was obtained through a combination of pressure from the public health field, cooperation from the chlorine manufacturers, and the use of material allocation powers by the federal government.

The emergency committees have now been consolidated into two groups: [1] the Joint Committee on Chlorine Supplies, representing the Conference of State Sanitary Engrs., the American Water Works Assn., the Federation of Sewage and Industrial Wastes Assns., and the U.S. Public Health Service; and [2] the Public Health Advisory Committee, created by the Chlorine Institute, Inc., and supplemented with advisory members from the U.S. Public Health Service, the Conf. of State Sanitary Engrs., the AWWA, the FS&IWA and other affected professional associations. A function of these committees is to consider and recommend appropriate action to insure an adequate and continuous supply of chlorine for water purification and sewage disposal plants and for other public health needs.

This important and timely analysis, of the practicability and potentialities of bulk-storage of liquid chlorine on customer's premises, is the outgrowth of the work of the Joint Committee on Chlorine Supply in its search for improved practices in the procurement, handling and use of liquid chlorine.

Authors Woodward and Hedgepeth developed this paper for presentation at the 1953 Annual Conference of the American Water Works Assn. in Grand Rapids, Mich., by special invitation. It is here printed by permission of the Association.

One of the problems presently being studied by both committees is the retention of shipping containers in users' plants for periods which the chlorine suppliers consider objectionably long and which the consumers in the water and sewage field consider necessary to maintain an adequate chlorine reserve for their essential facilities. The authors recognize that uninterrupted operation of these utilities is a primary public health necessity and that an adequate supply of chlorine *must* be provided for them. As this aim might be accomplished in more than one way, and as practices at one plant may be entirely unsuited to another, the authors make no recommendation on storage methods for specific plants. They do feel, however, that, under the right conditions and *with proper precautions, stationary bulk storage of liquid chlorine is practical and feasible.*

## Properties of Liquid Chlorine

An intelligent approach to the consideration of the storage of any material requires first that data on its properties be assembled. For chlorine, this information is readily available in the published literature and is conveniently obtainable from the chlorine producers or from the Chlorine Institute Manual[1]. Only the essential data will be presented in this paper.

Liquid chlorine is a clear, amber-colored liquid with a specific gravity of approximately 1.5. Its specific heat is 0.223 Btu per pound per degree Fahrenheit and its latent heat of evaporation is 110 Btu per pound at 70°F. At —30.1°F, (the boiling point) one volume of liquid chlorine is equivalent to 462 volumes of gaseous chlorine. Although this ratio is not too surprising for a compressed gas, it is nevertheless apparent that a very small quantity of liquid chlorine makes a substantial volume of gas. Because gaseous chlorine is approximately 2.5 times as heavy as air, it tends to accumulate in low places and is slow to diffuse into the air. Gaseous chlorine is, of course, liquefied by application of pressure at reduced temperature. At —30.1°F, the vapor pressure of chlorine is at atmospheric pressure or 0 psi gage; at 68°F, the pressure is 81.9 psi gage; and at 212°F, it is 539 psi gage. This relationship is shown in Fig. 1.

Fig. 2 shows the temperature-density relation of liquid chlorine; the rapid decrease in density with increasing temperature will be noted. This characteristic is most important, because the temperature-pressure relationship applies only when a vapor space is present. Any rise in the temperature of liquid chlorine when the vapor space is exhausted will result in the development of hydrostatic pressure of infinite limit and the rup-

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ture of the tanks. Consequently, Interstate Commerce Commission regulations limit the loading of chlorine containers to 125 per cent by weight of the water capacity at 60°F. Practically interpreted, this means that a cylinder of 120-lb. water capacity at 60°F may be legally loaded with not more than 150 lb. of chlorine.

As shown in Fig. 3, at a temperature of 60°F and under these loading conditions, the container is 87.8 per cent full of liquid. The liquid volume increases with the temperature, however, until, at 153.4°F, the vessel is 100 per cent liquid full. A further increase of temperature will cause hydrostatic rupture of the tank unless safety devices are provided. These are usually spring-loaded safety valves for storage tanks and tank-cars, and fusible vents for cylinders and ton containers.

At normal temperature, anhydrous chlorine, whether gaseous or liquid, can be handled in equipment fabricated from a variety of materials, including iron, steel, Monel, nickel, copper, brass, bronze, and lead. These materials are not seriously attacked by dry chlorine, but the presence of moisture will result in severe corrosion. Anhydrous chlorine at elevated temperature will attack metals. Chlorine, liquid or gaseous, is nonflammable and will not support combustion in the usual sense. Gaseous chlorine will, however, support the combustion of certain materials, such as combustible organics and finely divided cork, under normal temperature, and steel under elevated temperature. It reacts with oil at ordinary temperatures to form waxes that will gum feeding equipment.

The physiological effects of chlorine are not covered in this paper, but it is well to note that its odor is detectable in air at a concentration of 3.5 ppm, a nonhazardous concentration for ordinary exposures. At higher concentrations, danger may be present. For example, throat irritations may be experienced at 15 ppm, and a period of about 30 min. is the maximum safe exposure for concentrations of 40-60 ppm.

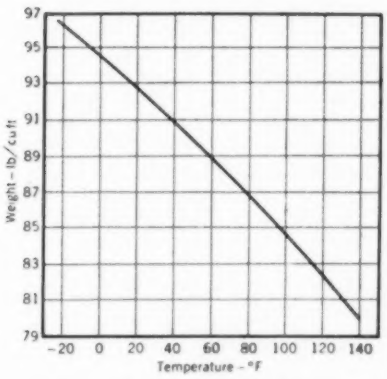



**Fig. 2. Temperature-Density Curve**
The rapid decrease in density with increasing temperature is an important factor in storage design.

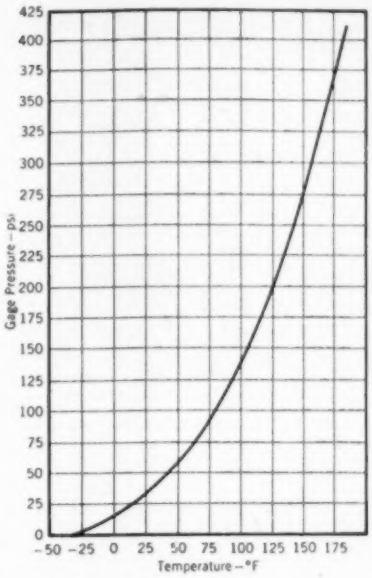



**Fig. 1. Temperature-Pressure Curve**
Gas and liquid exist in a state of balance for all conditions of temperature and pressure whose values meet on the curve.

## Storage Vessels

Pressure vessels for the storage of liquid chlorine would normally be of the horizontal type with dished heads. They must be fabricated in accordance with the applicable code requirements of the state and city in which they will be used. Minimum standards of fabrication should be the ASME "Code for Unfired Pressure Vessels"[2].

As an illustration, the ASME code may be applied to the design of a horizontal storage tank to contain a maximum loading of 55 tons of liquid chlorine. Assuming that the tank has a 90-in. ID, and is 30 ft. 3 in. long on the straight side and 34 ft. long including elliptical heads, it would have a volume of 1,447 cu. ft. Based on the accepted practices under the ICC regulations, the chlorine capacity would be $1{,}447 \times 62.4 \times 1.25 = 112{,}866$ lb. With a design pressure of 250 psi, equivalent to the vapor pressure at 142°F, carbon-steel plate having the specification number SA-212, Grade B, is selected from Table UG-23 of the 1950 ASME code. This material has a minimum tensile strength of 70,000 psi and a maximum allowable working stress of 17,500 psi for metal temperatures not exceeding the range —20°F to +658°F. The shell thickness, computed in accordance with UG-27, is 0.730 in. Added to this is a 3/16 in. corrosion allowance, establishing a shell thickness of 7/8 in. Using a standard elliptical head of 2:1 ratio, the head thickness, calculated in accordance with Par. UG-32D, is 0.64 in., which, with the same allowance of 3/16 in. for corrosion, would give a head thickness of 7/8 in. The tank would be electric fusion welded, the welds to be continuous on both sides.

For the material specified, SA-212B, the code requires stress relief and radiographic examination only if the thickness is at least 1 in. Because of the dangerous nature of the contents, the authors recommend, nevertheless, that the vessel be both stress relieved and radiographed.

To the basic tank must be added appropriate access manholes for inspection, and nozzles for safety valves, chlorine inlet, chlorine outlet, chlorine vent line, compressed air line, and tank pressure gage. The arrangement used is optional with the designer, but there is some advantage in grouping several on the cover plate of a large nozzle or manhole. (Fig. 5)

It is recommended that the completed tank be subject to a final inspection at the time of the hydrostatic test and be provided with a code stamping. The design of the tank must, of course, take into account its support, with stiffening rings employed where required.

Insulation of the tank is recommended to avoid sweating and resulting corrosion during frequent periods of low temperature and to minimize the effect of ambient and radiant heat on the storage pressure. Adequate insulation is furnished by 4-in. cork board.

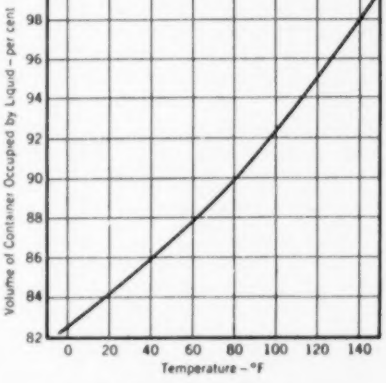



**Fig. 3. Volume-Temperature Curve**
The percentages apply to containers carrying the legal maximum load permitted by ICC regulations.

### Appurtenances

In general, pipelines for handling liquid chlorine or dry gas should be fabricated from *extra-heavy* black iron pipe. Joints should be welded or flanged, using tongue and groove flanges. The standard ammonia type of flange is preferable, as its use permits easy inspection and repair of lines. A minimum number of fittings is desirable; when necessary, fittings of forged steel will serve. Gaskets should be made of lead containing 2-3 per cent antimony or of compressed asbestos. Rubber gaskets are not suitable.

Long lines conveying liquid chlorine should be protected with a valve at each end and should be provided with an expansion chamber, so that, if both valves are closed and the line is exposed to increased temperatures, the expansion chamber will provide for the increased volume of liquid and prevent hydrostatic rupture. A standard 100-lb. chlorine cylinder, inverted, mounted vertically, and connected into the line at its highest elevation, serves very well for most typical requirements. Unusual cases may warrant multiple expansion chambers.

Only valves designed for chlorine service should be used. The standard Chlorine Institute angle valve employed on ton containers can be adapted to many installations. For general service, however, valves of forged-steel construction with Monel trim are preferred. Plug valves with outside screw and yoke, flanged and bolted bonnets, screwed bodies, and deep stuffing boxes using graphite-asbestos rope packing give good service. (See Fig. 4)

Gages for chlorine should be of the diaphragm type, designed for chlorine service. Their range should be 1.5 times the relief pressure of the safety valves. These likewise should be designed for chlorine service. The type most generally used is a spring-loaded reseating valve, constructed chiefly of steel and Monel, as designed by the Chlorine Institute. It is provided with a protective mechanism, that prevents chlorine from entering the working parts of the valve until operated by excess pressure.

### Loading and Maintenance

The amount of storage capacity to be installed is an important consideration. The minimum capacity required equals the smallest single-unit tankcar (16 tons), plus allowance for variation in scheduled arrival of cars. This allowance might be computed as the average daily consumption of chlorine times the largest number of days between the placement of an order and the receipt of the chlorine. Relatively high rates of consumption may make it desirable to be able to receive the 30-ton cars, or even the maximum-size single-unit car of 55 tons. Finally, the capacity may be determined strictly on the basis of a predetermined policy to maintain a minimum stock of chlorine (in terms of number of days, weeks, or months) on hand at all times. As the size of the chlorine tankcar to be used and the shipping time required are factors best known to the chlorine producer, it is advisable to obtain his assistance in deciding on the amount of storage capacity to be provided.

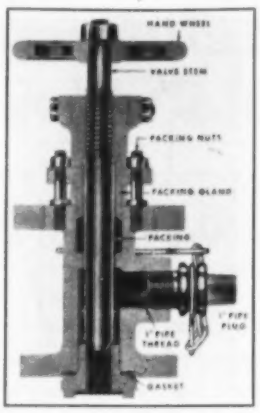



**Fig. 4—Cross-section of type of valves used on single-unit chlorine tank cars. (See Fig. 5)**

(Ed. Note: Neither Fig. 4 nor Fig. 5 were supplied by the authors. We have added these to assist the reader visualize the valving and tank construction requirements in connection with stationary bulk-storage of liquid chlorine.)

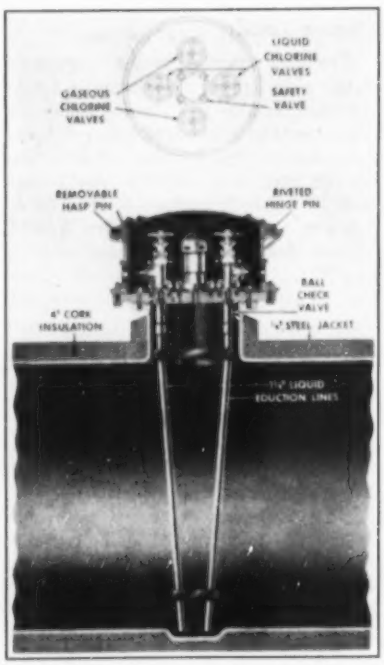



**Fig. 5—Cross-section of valve dome and center portion of chlorine tank car.** Note that valves for gas release or compressed air input (padding); and, valves for liquid withdrawal or filling are in duplicate. Safety valve is in center of dome.

Several considerations indicate the advisability of having the storage capacity in the form of two tanks of identical proportions. First, it is necessary that the pressure in the storage tank be reduced below that of the tankcar (preferably to atmospheric pressure) before filling, and kept at the lower pressure if a reasonable filling rate is to be maintained. With a single storage tank delivery to the point of consumption and uniform chlorination of the water will be difficult, if not impossible, during the filling operation. With two tanks, this difficulty is circumvented.

Second, it is desirable, and necessary under the regulations for the maintenance of pressure vessels, to inspect the storage tanks at regular intervals. During the appreciable period required to prepare the tank for inspection and during the actual inspection itself, either a second storage tank or a tankcar will be needed to maintain a continuous flow of chlorine to the feeders.

Provision must be made for determining the contents of the storage tank. This is desirable for inventory purposes and *is essential to avoid dangerous overfilling.* Overfilled tanks are liable to hydrostatic rupture, or the opening of safety valves and the discharge of chlorine. Of the many possible solutions, none exceeds in simplicity and reliability the use of scale-mounted tanks. Unfortunately, this is probably also the most costly means. However, this added first cost cannot sanely be argued as a sufficient reason to rule out this all important safety measure in operating a stationary chlorine storage vessel.

Internal devices, to indicate degree of loading, including floats, buoyant tubes, and balanced diaphragms, although excellent in themselves, have a serious drawback in that the tank must be emptied to permit servicing.

External devices that, in effect, serve to weigh the tank and contents avoid this difficulty. Representative of this group are the Taylor load elements. When first cost is of serious moment and provision for adequate servicing is available, these can prove satisfactory.

### Chlorine Withdrawal

The withdrawal of liquid chlorine from the stationary storage tanks for use in the feeder is essentially the same as withdrawal from a tankcar.

This matter will not be dealt with, as the recommended safe practices are well known to chlorine consumers and are described in publications issued by the Chlorine Institute and by chlorine manufacturers. Transfer from a tankcar to intermediate stationary storage does, however, involve additional problems, the solution of which is essential to the safe and satisfactory use of such tanks.

The stationary storage tank in use will be working at a pressure equal to the vapor pressure of the chlorine at the temperature prevailing, or at a higher pressure if "air padding" is used. ("Air padding" is the addition of *moisture-free* and *oil-free* compressed air to the vapor phase area above the liquid chlorine in the storage tank or tankcar.) It is, therefore, more than likely that, at the time it is desired to transfer chlorine from tankcar to storage, the pressure in the storage tank will be equal or so close to that of the tankcar that adequate unloading rates for the chlorine will be impractical. Thus, it is necessary to provide a means of venting chlorine gas from storage tank in order to lower its pressure and permit transfer. Such venting may be necessary during the entire transfer period.

Facilities must be available to absorb or otherwise dispose of the chlorine or chlorine-air mixture released during such venting. The nature of these facilities will, of course, vary with the conditions existing at the particular site. Under the most favorable circumstances the gas might be vented to the consuming process, thus avoiding waste of chlorine. Should this procedure not be practical, under the worst conditions it might be necessary to provide equipment to absorb the gas in an alkaline solution circulating over a scrubbing tower properly designed to handle wet chlorine gas. Under other conditions, venting waste chlorine gas to a large sanitary sewer, or to an active, high smoke stack, may be the best and simplest solution. The importance of this matter of venting and disposal of vent-gas cannot be overestimated. The attendant problems in a particular situation may, in themselves, render stationary storage impractical for the water plant.

Movement of chlorine from stationary storage to the feeders during the filling operation is at best inconvenient and, depending on the pressure required, may not be feasible. Under such conditions, the need for two storage tanks is apparent. The use of bypasses, multiple-pressure-level operation, and other devices to get around this problem are in general unsatisfactory, as they tend to increase the complexity of maintenance and operation of the facility, and thus add to the hazards. The installation in a water plant must be amenable to simple, straight-forward operating procedure. No water plant can risk a shutdown due to non-dependability of chlorinating facilities.

### Concerning Air Padding

As mentioned earlier, air padding of the storage tank may be necessary to provide an adequate working transfer pressure. *The air used must be dry and free of oil.* To avoid any possibility that chlorine will inadvertently enter other parts of the plant through connecting air lines, a small, separate compressor, used solely for this purpose, should be provided. The air should be dried in regenerative units containing activated silica gel or activated alumina yielding dew points of —50°F. Moisture will promote serious corrosion of valves and piping, as well as of the tank itself. To protect the air compressor and drier, check valves and stop valves must be provided in the air line to the tank, all of which are to be suited to dry chlorine gas service, as well as air.

### Tank Inspection and Servicing

A detailed description of the requirements and procedures for preparing the storage tank for inspection will not be given here. The inspection itself must conform to the codes of the area, which may also affect the design. Provision must be made to permit removal of as much liquid chlorine as possible from the tank. Venting of chlorine gas remaining after the liquid is removed, with reduction of pressure to atmospheric, is necessary. Washing of the tank may be required, with attendant provision for continuous flushing of the tank to avoid local corrosion by chlorine water. Finally, the atmosphere in the tank should be rendered safe for personnel, although limited inspection by qualified experts using full protective equipment and suitable masks may be feasible.

### General Considerations

Certain general considerations warrant discussion. Even if every normal hazard is foreseen, human or equipment failure may still occur. The tank, therefore, should be as remote from buildings as practical, so that neither gas nor liquid may enter and perhaps trap the occupants. Similarly, the tank nor the liquid chlorine line should be near combustible buildings or material, because heat, as previously noted, will greatly accelerate the action of chlorine on the steel, with the possible release of the contents. The location of stationary storage tanks in or near areas of high occupancy should be avoided. Where such installations are necessary, more stringent safety measures must be adopted, such as the provision of a standby evacuated tank to permit transfer of the contents of the working tank in an emergency.

### Conclusions

The elements of those practices for the safe storage of liquefied compressed gas that are applicable to the storage of liquid chlorine have been outlined on the basis of experience and information believed to be reliable. Space limitations preclude a complete listing of all requirements for safe storage practice, and those interested are urged to make a thorough study of the matter before undertaking the stationary storage of liquid chlorine in tankcar lots. The authors do not wish to be interpreted as advocating nor disapproving the storage of liquid chlorine in stationary pressure vessels at specific water purification and sewage disposal plants. Such storage installations should always be preceded by a comprehensive engineering study and a careful precautionary review of the pertinent facts by the management.

#### References

1. Chlorine Manual. Chlorine Institute, Inc., New York (1st ed., 1947).

2. Code for Unfired Pressure Vessels. Am. Soc. Mech. Engrs., New York (1950).

## Aerial Pictures Better Than Water Witching

Aerial photographs are valuable in helping geologists to find underground water sources, the United States Nations Educational, Scientific and Cultural Organization says.

The pictures are used to distinguish between the types of sandstones, limestones and shales and to recognize granites and volcanic rocks. They also aid in identifying soil as sand, silt, gravel or clay.

With this information available, a water expert can locate, with considerable accuracy, what probably are new sources of water. He also can forecast the potential yield of water from any source and the depth of drilling required to tap the water reserves.

# Demand Charge Approved for Water Service in Air-Cooling*

Arkansas Public Service Commission approves. Demand Charge based on data assembled and analyzed by General Waterworks Corporation.

by J. R. PIERCE, Vice-Pres. & Genl. Mgr. General Waterworks Corp., Pine Bluff, Ark.

ENGINEERS and water works men are becoming increasingly concerned over the problem of rising water demands created by the use of air conditioning without recirculatory equipment. Although an immediate gain in revenue may result, a thorough analysis indicates that abnormally high demands upon supply, plant and distribution system facilities can prove very costly to the water consumer, and sometimes disastrous to the institution owning the facilities.

The author's firm, searching for a solution that would benefit both its customers and itself, first considered curtailment of service. As the company is in business to sell water and service, however, it was felt that the restrictive approach would be extremely unpopular with the public. An equitable solution was to have the customers who were creating the abnormal demand pay to support the fixed charges essential to provide this type of service. It was therefore decided to establish a demand charge on unconserved air-conditioning water use without auxiliary cooling equipment.

## Data Assembled

The company assembled the necessary data and filed it with the Arkansas Public Service Commission. (The method by which the demand charge was determined appears at the end of this paper.) The commission authorized a charge of $2.50 per ton per month during May, June, July, August, and September for air conditioning of 3 tons or more without recirculatory equipment.

The major reason for the action taken by the company was the situation existing in its largest system in Arkansas, which was used as evidence at the public service commission hearing. A company survey found that 10.2 per cent of all water sold was being used for cooling and wasted through the sanitary sewer system. This waste was caused by only 1.2 per cent of the total customers. Based on the growth trend of air-conditioning installations, statistics revealed that in 5 years the connected tonnage would increase from 1,593 to 6,395 and the air-conditioning users would increase to 15 per cent. Assuming that the tonnage connected without recirculatory equipment remained at 23.6 per cent, the peak month cooling-water use would more than double in 5 years. This tremendous increase in demand would require that production and plant facilities be doubled and huge sums spent on strengthening the distribution system. Rate increases to support such an investment would be enormous and would rightfully be frowned upon by the customers, all of whom would be affected, even though the damage would have been created by only approximately 15 per cent of the total.

## Most Favorable Evidence

The most favorable evidence presented at the hearing concerned the net savings that the customers could realize by installing conservation equipment. A thorough study was made of all types of recirculatory equipment. From data on first cost, life expectancy, annual maintenance, and operating expense, and assuming a 15-year amortization of the initial investment at 6 per cent, it was found that the customer's savings on the cost of water at prevailing rates (before the demand charge) would pay for the average recirculatory installation in 3 years.

The demand charge was authorized July 1, 1952, to go into effect in 1953. The customers affected were notified long enough in advance so that they would have ample time to purchase and install recirculatory equipment before the effective date of the charge. The company informed these customers of the savings that would accrue to them through the installation of the equipment and recommended its adoption to avoid the demand charge.

This peak load problem can in some measure be attributed to overzealous dealers in air-conditioning equipment. Many customers with unconserved air conditioning were ignorant of the saving in water cost provided by recirculatory equipment, as the dealer was afraid that its high first cost would cause him to lose a sale if he recommended it. As a result, the customer would complain to the utility when he began receiving high water bills. Even when he learned that the amount of water required, 2-3 gpm per rated ton, and was told of the advantages of conservation, he often preferred to pay the high water bills rather than make the initial expenditure for the recirculatory equipment. The demand charge, in addition to forestalling unreasonable rate increases, helps to encourage the reluctant customer to install conservation equipment.

## Factors

### In Determining Demand Charge

*(a).* Peak monthly unconserved air-conditioning demand.

*(b).* Number of months air conditioning is used (demand charge payable during these months).

*(c).* Number of months in which water plant capacity chargeable to air conditioning is *not* used $(12 - b)$.

*(d).* Total gallons per year on which demand charge should be paid $(a \times c)$.

*(e).* Allocation of *(d)* to months in which demand charges will be collected $(d \div b)$.

*(f).* Tons of unconserved air conditioning.

*(g).* Allocation of *(e)* to unconserved air-conditioning tonnage $(e \div f)$.

*(h).* Total gallons sold in year.

*(i).* Total annual operating expense—(source of supply, pumping, purification, transmission and distribution and general).

*(j).* Operating expense per gallon sold $(i \div h)$.

*(k).* Sale price of water per gallon (at rate step for usage above normal).

*(l).* Fixed charges per gallon (sale price per gallon less operating expense per gallon, $k - j$).

*(m).* Demand charge per ton per month $(g \times l)$.

*This paper, presented before the 1953 Annual Conference of the Am. Water Works Assn., in Grand Rapids, Mich., is here printed by permission of the Association.

# Meeting of Maryland-Delaware Water and Sewage Assn.

## Annual Conference Held at Ocean City, Md.

FOR its 26th Annual Conference, May 21 and 22, 1953, the Maryland-Delaware Water and Sewage Assn. made a repeat visit to the Commander Hotel, Ocean City, Md. A more suitable and pleasant meeting location would be difficult to find.

Attendance at technical sessions proved that the 150 members came for business as well as to enjoy themselves. The official banquet (and an *unofficial* late lunch), and ladies entertainment were also important parts of the program.

**Officers**

**Outgoing President**
Victor W. Faivre
Superintendent
Sub. Water Corp.
Claymont, Del.

**Incoming President**
Roy H. Ritter
Partner
Whitman, Requardt
Baltimore, Md.

The Maryland-Delaware Association is proud of its group spirit: its original and continuing aim has been to foster the training and emphasize the supplying of information for small plant operators. The chief sanitary engineers of Maryland, Delaware, and of the District of Columbia are regular members of the Executive Committee of the Association.

### New Officers

The following officers were elected to serve for the coming year:

President
Roy H. Ritter
Partner, Whitman, Requardt & Associates
Baltimore, Md.

First Vice-President
E. F. Donaldson
Chief Engr., Municipal Water Works
Annapolis, Md.

Second Vice-President
R. L. Nichols
San. Engr., Hq. 2nd Army
Ft. Geo. G. Meade, Md.

Member Executive Committee
Earl D. Krapf
Asst. Chief Engr., Street & Sewer Dept.
Wilmington, Del.

### Business Meeting

The F.S.&I.W.A. President, Louis J. Fontenelli, attended the meeting and reviewed briefly "a quarter century of progress" in the field of sewage and industrial waste treatment. Growth of the Federation to the present 38 member associations, its useful Journal and manuals of practice, were cited as evidence of the value of this organization.

Ralph E. Fuhrman was selected by the award committee of the Maryland-Delaware Association to receive the Bedell Award, in recognition of his many contributions to advancement of sewage treatment plant operation.

The Short Course for operators will be held next September 9-11 at the University of Maryland, it was announced.

Frederick, Md., will be host to the 1954 meeting of the association.

### Technical Program

VICTOR W. FAIVRE, Supt., Wilmington Suburban Water Corp., Claymont, Del., outgoing President of the Md.-Del. association presided at sessions on the first day of the meeting.

**Bedell Award Winner**
Ralph E. Fuhrman
Deputy Director
Water & Sewage Dept.
Washington, D. C.

**Federation President**
Louis J. Fontenelli
Superv. Engr.
Rahway Jt. Meeting
Garwood, N. J.

"ABANDONING AN OLD AND STARTING A NEW WATER FILTRATION PLANT" was the story told by Robert E. Greenshields, Supt. of Power and Maintenance, Springfield State Hospital, Sykesville, Md.

Among the five state hospitals, that at Sykesville is the most complete and self-contained—its telephone system being the only outside utility. (In its 1,387 acres, 700 are under cultivation; 500 are used for buildings and grounds; 51 acres are in grass; and there are 150 buildings.) In addition to an electric generating station, there are now modern 750,000 gal. per day water filtration and sewage treatment plants.

Water and sewage needs for the hospital are as large as those required by a population of 17,000 (such as for the city of Easton, Md.), because requirements for each patient are six times those normally found in a community. The original filtration plant was abandoned because its various units were not only inadequate in capacity but incapable of expansion (maximum capacity was .655 mgd).

**Officers**

**First Vice-Pres.**
E. F. Donaldson
Chief Engr.
Water Works
Annapolis, Md.

**Executive Comm.**
Earl D. Krapf
Asst. Chief Engr.
Street & Sewer Dept.
Wilmington, Del.

The new low lift pumping station, treatment plant, and high lift pumps are designed to operate on a completely automatic basis. Consulting engineers Whitman, Requardt and Associates designed a plant to which additional filter units and sedimentation basins can readily be added when increased capacity is required.

### More Water from Wells

"CLEANING WELL SCREENS" was the title of a paper presented by Louis R. Caplan, Mgr., Washington office, Calgon, Inc., Washington, D.C. The simple and standardized procedure he described appears to have such wide application that *Water and Sewage Works* has arranged to publish his paper in full.

Briefly, glassy phosphates have such excellent dispersal properties that they may be used to enable much suspended matter to be flushed from areas around well screens and thus increase capacity.

**THREE speakers came prepared!**

(LEFT) Greenshields: "Brought rope to hang himself." (RIGHT) Caplan: "Named his own poison." (CENTER) Levin: "Enough papers to speak three hours." [Above their heads, not daggers, but the fins of a mounted fish.]

The operation requires introducing 30 lb. of Calgon and 1 to 2 lb. of hypochlorite per 100 gal. of water in the well. After 24 to 48 hours, the well is surged ten or twelve times by pumping water to the ground level and then turning the pump off (higher pumping is helpful when the system includes a standpipe).

Repetition of the treatment from 3 to 5 times may be necessary, but about 95 per cent of plugging problems may be solved by this treatment. Many industrial wells make regular use of this process; i.e., scheduled cleaning is used to maintain well capacity. The paper describes specific examples of results.

### Swimming Pool Filters

"Diatomaceous Earth Filters for Swimming Pools" were evaluated in a paper listed with William H. Cary, Jr., Director, Bur. of Public Health Engineering, Washington, D.C., as the author. The paper was presented by Gilbert Levin, Public Health Engr., D.C. Health Dept., Washington.

During World War II the U.S. Army carried on extensive development work at Fort Belvoir to increase the filtration rates of the available diatomaceous earth filter units; this resulted in the selection of cores of various types which appeared to be suitable, and in the commercial development of several types. There are six filter units of this nature installed in Washington, D.C., swimming pools—indoor and outdoor—and their operation was summarized over a period of 7 years.

Major difficulties reported: Galvanic action was found to occur in Monel-wound plastic cores; corrosion was exhibited by 100 of 300 cores examined. The result was that the wire spalled off and diatomite filter aid passed through. These elements were poorly manufactured, and the corrosion appeared caused by excess chlorine gas which was liberated by cavitation when the unit was in operation.

Another type of unit which failed was that using a concentric wire-mesh core. In this instance a mixture of diatomite and clay which completely clogged the elements formed a "good grade of adobe."

**Association Wheelhorses**

A. M. Tawney
San. Engr.
Post Engr. Office
Fort Meade, Md.

E. R. Eyler
Sales Engr.
Rockwell Meter Co.
Baltimore, Md.

General considerations indicate filters of this type are liable to corrosion because of galvanic action and fine tolerances. Inadequate backwash is evident; at least once each year, units should be disassembled and cleaned manually. (Swimming pool water differs from raw water in its high content of grease and body oils.)

Air-bump backwashing and use of mechanical air compressors have been found to satisfactorily clean diatomaceous earth filter units, when rates 100 to 200 times the maximum filtering rate can be used in backwashing; units must be sturdily built for such operation. Finally, the operators should be properly schooled—they are the most important factor in the problem.

To lengthen the service life of these units, better design, specification, and manufacture of diatomaceous earth filters was recommended—even specific requirements for a particular job. Minimum use should be made of dissimilar metals, and wash rates must be considerably increased. Properly made and operated, this type of filter can fill a very useful need.

### Poultry Packing Wastes

"Characteristics of Poultry Packing Wastes" were described in a paper presented by A. Joel Kaplovsky, Supervising Engr., Water Pollution Commission, Dover, Del.

Poultry growing and packing is "big business" in Delaware, as many as 6 to 7 thousand chickens may be killed per hour in one installation. The flushing of wastes (equivalent to strong domestic sewage in strength) creates a large pollution load.

Sedimentation has little effect on the color removal; trickling filter treatment is satisfactory if adequate capacity is provided; and digestion treatment may constitute suitable treatment. Experiments show that a 20 per cent reduction in B.O.D. may be accomplished by chlorination—and a 100 to 150 ppm dosage will result in color reduction. Proper "dry cleaning" will be most effective in reducing the pollution load.

### Pumping Problems

"Sewage Pumping Stations on Water Supply Reservoirs" were described by William F. Neale, Whitman, Requardt & Associates, Baltimore, Md.

The author reviewed many problems of this nature confronting municipal engineers as suburban areas are built up, and as long force mains must be operated. One problem is that of power "outage." An alarm system may be adequate where there is adequate holding capacity, or an auxiliary power source may be necessary.

Design of pumping stations (and redesign) may be difficult, as planning for future capacity needs is difficult to predict. Auxiliary power needs are best met by gasoline engines directly connected to pumps, and cooled by radiation.

### Design of Storm Inlets

"Storm Water Inlets—Rainfall and Runoff" were discussed by Bernard F. Suwall, Principal Associate Engr., Baltimore, Md., who used many lantern slides to illustrate the action and effect of many types of inlets.

Studies extending over several

years have led to the development of improved designs which increase intake rates (up to 3.9 cfs). The most effective design appears to be an inlet constructed entirely of longitudinal bars (cast steel).

Field tests have demonstrated an upstream location of inlets to be most effective. The study has become a research project at Johns Hopkins University, where laboratory scale models are found to adequately simulate field conditions. This work is continuing.

**Programmers**

B. F. Suwall
Prin. Assoc. Engr.
Bureau of Sewers
Baltimore, Md.

A. J. Kaplovsky
Superv. Engr.
Pollution Comm.
Dover, Del.

R. M. Brown
Engr.
State Health Dept.
Baltimore, Md.

W. F. Neale
Engr.
Whitman, Requardt
Baltimore, Md.

### Regulated Sanitation

"Regulations for Controlling Sanitation of the Environment" was the title of a discussion by Robert M. Brown, Chief, Bureau of Environmental Hygiene, State Dept. of Health, Baltimore, Md.

Mr. Brown illustrated the complexities in developing and in utilizing regulations — and emphasized that they are not the basis of a successfully operating public health program.

The role of official regulations to control sanitation of environment must be based on a shared responsibility in *developing* and *applying*. The regulations must be based on the best available scientific data and operating experience in order to be practical, enforceable, and gauged to meet demonstrated needs.

Where regulations must, by reason of necessity, infringe upon the freedom of action of individuals or groups, the public need must be weighed most carefully against economic requirements. The regulations must be capable of justification when brought to test in the courts. They must command the support and respect of the people at large.

The public information or education processes to complement the regulations are probably even more essential to the development of a successful program. This motivation, rather than coercion, Mr. Brown pointed to as the key to acceptance of environmental sanitation regulations.

### New Financing Law

"Authority Law Operation for Water Supply and Sewerage," was a topic reviewed by Clarke Gardner, Gardner and Sterling, Consulting Engineers, Salisbury, Md.

Recognizing the need for developing adequate water and sewage facilities, and to provide means for financing these essential improvements in many communities throughout Maryland and Delaware, state-wide legislation has been sponsored by the Maryland State Dept. of Health and the Delaware Mayors' Association, actively supported by the Delaware Board of Health and the Water Commission. Both acts are patterned after the Pennsylvania law.

**Programmers**

Clarke Gardner
Partner
Gardner & Sterling
Salisbury, Md.

Louis R. Caplan
Manager
Calgon, Inc.
Washington, D. C.

Mr. Gardner described organization procedure under the Maryland Law and the proposed Delaware Bill.

Summerfield B. Pearson, Alex. Brown & Sons, Investment Bankers, Baltimore, Md., provided additional discussion. He described the functions and operations of an authority—summarized as "whatever may constitute a sound business venture is the criteria of action of an authority."

### Salisbury Incinerator

"Design and Operation of the Salisbury Incinerator" were described by Percy Sterling, Gardner and Sterling, Consulting Engrs., Salisbury, Md.

To cope with the problem of refuse and sewage, a Salisbury Incinerator and Sewage Treatment Plant Commission was created in 1945. The incinerator has a capacity of 125 tons per 24 hours (to handle the maximum days capacity of 44 tons of refuse in about 8 hours), and is guaranteed to operate without the use of outside fuel when the refuse is 65 per cent garbage and 35 per cent rubbish (moisture content 50 per cent and incombustibles not exceeding 15 per cent). The incinerator unit was built and installed by the Nichols Engineering and Research Corp. Total project cost was about $280,000.

Philip C. Cooper, City Engr., Salisbury, Md., discussed the paper and reported on operation experience.

Extended spring rains resulted in garbage having a moisture content of as much as 80 per cent. The use of supplementary fuel proved necessary, and expensive. New regulations were established by law—they have effected garbage collection having sufficiently low moisture content to keep within design limits of the incinerator, and are strictly enforced.

## Milwaukee Water Works Now Completely Debt Free

For the first time since the Milwaukee Water Dept. was established some 81 years ago (1872), the water works of Milwaukee is now completely free of all debt.

On June 30th the water department made its last payment of $200,000 in bond interest and principal which completely eradicated the remaining debt against the water works.

For the past 14 years the water department has been earning a net return sufficient to make possible the payment of interest and debt retirement at the rate of $200,000 each year.

[Ed. Note: We have often commented on the worth of State Public Service Comm. regulation of rates and supervision of financial operations of publicly-owned water utilities in Wisconsin. Here, again, is another bit of evidence that regulated water rates of Wisconsin municipalities have been adequate for the most part to provide adequate facilities, while also providing a surplus for debt retirement at a satisfactory rate.]

# Fundamental Principles of Handling Chlorine

## II—Chlorine Feeders

by V. W. LANGWORTHY, Research Chemist, The Chlorine Institute, Inc., New York

Chlorine is a widely used tool in the treatment of water, sewage, and industrial wastes. Fundamental knowledge of handling this tool is important because of its potentially hazardous characteristics.

In this series of articles on handling chlorine, Mr. Langworthy summarizes useful information and describes good practices. Each article has been designed to be of practical value to all users of chlorine.

THE FIRST article in this series was devoted to discussing the characteristics and handling of packages in which commercial liquid chlorine is available*. In this installment, several types of chlorine gas feeders will be described, together with principles of their operation and maintenance.

Chlorine dispensing equipment is designed to control, measure and apply chlorine in the *gaseous* phase. Serious difficulties arise when attempting to secure accurate metering of *liquid* chlorine. The following statements apply generally, and reveal important reasons for designing equipment to handle gaseous chlorine:

1. Chlorine in the gas phase lends itself readily to constant pressure control.
2. Chlorine gas feed may be controlled either manually or automatically.
3. Gaseous chlorine may be metered with either visual or orifice type flow meters, with or without recording instruments.
4. Chlorine gas is readily diffused into a liquid medium at the point of application.

*Part I of this series appeared in the June, 1953, issue of *Water & Sewage Works*.

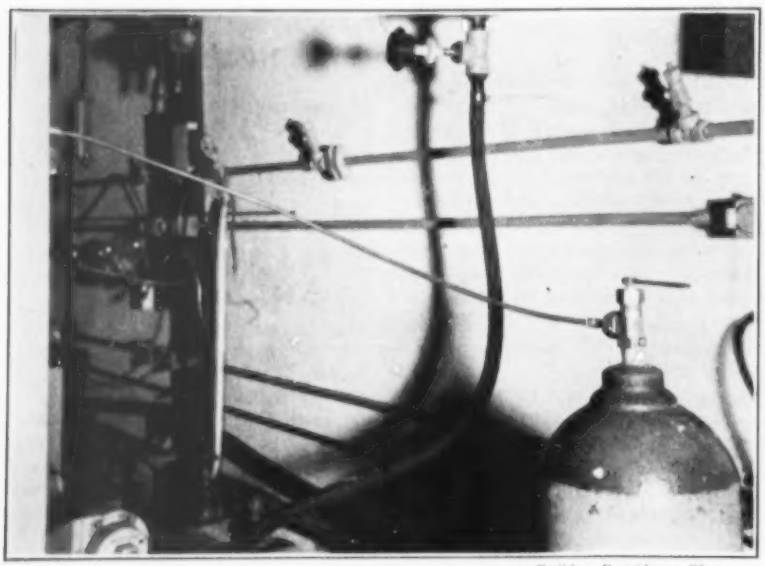
### Operating Principles

Equipment for dispensing gaseous chlorine is designed to utilize the principles of pressure (direct) feed, or of vacuum feed. The dispensing apparatus is connected either to the outlet valve or a cylinder standing vertically (Fig. 1), to the upper outlet valve of a horizontal ton container, to the gas valve of a single unit tank car, to the outlet regulator of a vaporizer, or to a valve located in the chlorine gas piping system.

The accuracy of a chlorine gas metering system relies basically on constant temperature and pressure conditions. The piping system delivering chlorine gas to the measuring device must be free of loops or pockets and avoid areas of low temperature, such as windows and cold walls. It is desirable to protect chlorine gas lines against temperature changes by insulating the piping system where necessary. Many operators install pressure controlling devices adjusted to maintain pressure within the temperature range where chlorine will not reliquefy in the chlorine piping system.

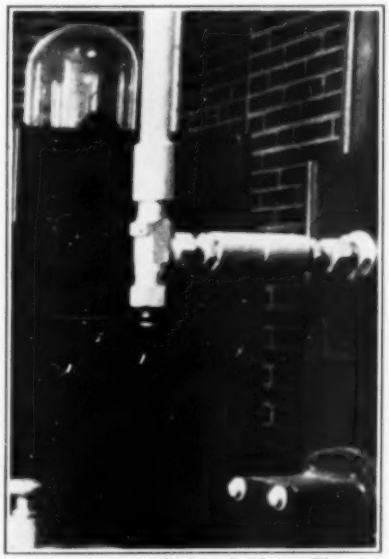
It is suggested that a check of injector operation be made each time a vacuum chlorinator is placed in service. It would appear obvious that if an injector will pull air through the vent lines, for example, it will remove chlorine gas.

All types of chlorine feeding devices are connected to the chlorine



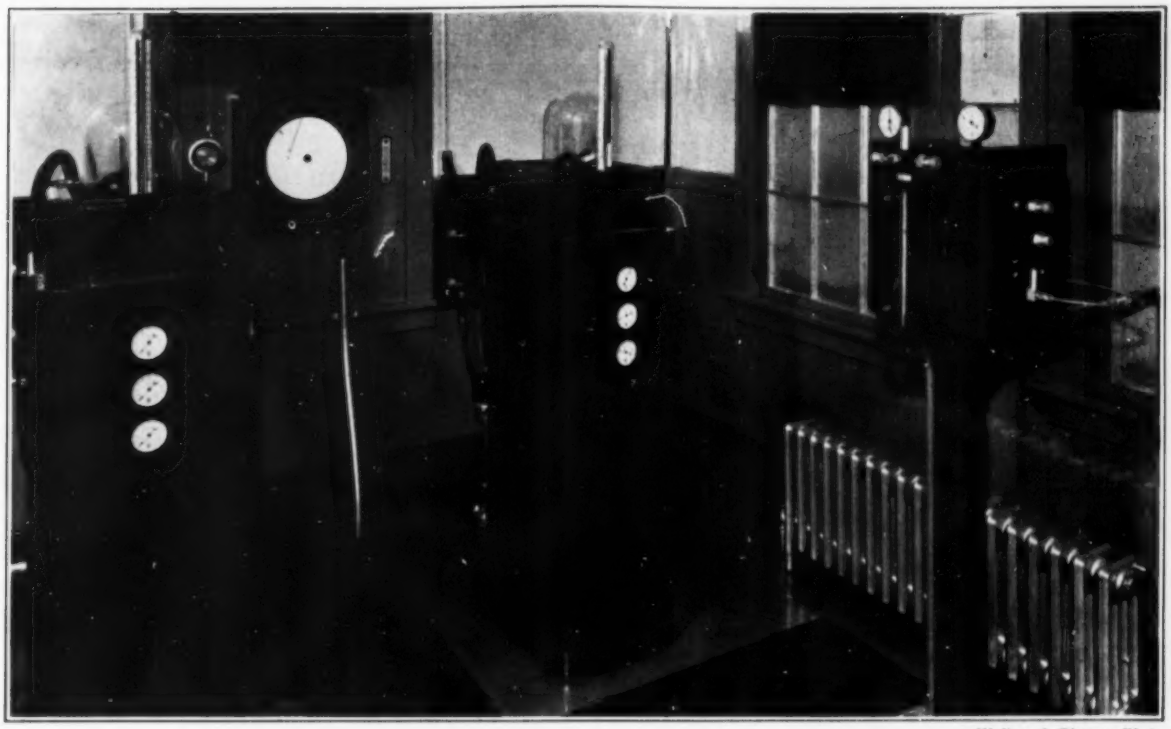
*Builders-Providence Photo*

**Fig. 1—CONNECTION of chlorine feeder to chlorine cylinder**
Flexible tubing conveying gas should slope upward from the cylinder.



*Wallace & Tiernan Photo*

**Fig. 2—VALVE in chlorine supply line**
Union coupling connects line to feeder.



*Wallace & Tiernan Photo*

**3—CHLORINATORS, two visible vacuum type chlorine feeders, and an ammonia feeder**

Compact installation in the headworks of the Tacoma, Wash., Water Dept.

piping system in such a manner that chlorine flow may be valved off when the feeder is out of service (Fig. 2).

## Vacuum Feed of Chlorine

### (Visible Vacuum Type)

Feeders of the visible vacuum type are characterized by a glass bell jar which encloses the chlorine pressure reducing valve, metering orifice, and vacuum relief float; it may or may not enclose a calibrated feed rate tube. Chlorine is confined within the bell jar by means of a water seal maintained by an auxiliary water line. Two chlorine feeders of the visible vacuum type are illustrated in Fig. 3.

#### Chlorinator

As the name implies, chlorine may be fed by a visible vacuum Chlorinator* only when a condition of partial vacuum exists within the bell jar, and when all valves in the chlorine piping system are open. Pressure less than atmospheric is maintained within the bell jar by means of a water operated injector. The injector also removes chlorine at a rate dependent upon the metering orifice size and the amount of negative pressure within the bell jar.

*Product of Wallace & Tiernan Co., Inc., Newark, N.J. The term is also applied to a product of the Chemical Equipment Co., Los Angeles, Calif.

Chlorine gas is, therefore, mixed with water at the injector, and the mixture flows to the point of application through rubber hose or other materials resistant to chlorine water. The volume of water required to operate the apparatus may be minimized by correct sizing of injector throat and tail piece, as well as by proper feeder selection.

All those components of the visible vacuum chlorinator that are exposed to moist chlorine are constructed of corrosion resistant materials. Preventive maintenance is indicated, however, in the interests of long and economical service. As one would expect, chlorine within the bell jar takes on moisture from tray water used as a seal, hence good practice would involve removal of chlorine from the bell jar when taking a feeder out of service for any reason. This is accomplished by closing the valve on the chlorine supply line allowing the injector to continue in operation. Reduction of the gas pressure on the water seal surface will permit air to be drawn in through the vacuum relief line. Sufficient time should be allowed for complete chlorine removal from the bell jar, since minute amounts of moist chlorine exert great corrosive action.

In maintenance of the equipment, special attention should be given to the chlorine pressure reducing valve. Free movement of the ball float can be assured by preventing excess scale formation on the valve and seat. Extreme care must be exercised in cleaning this valve, so that the valve stem and seat are not damaged. Bell jar surfaces should be kept clean to permit visual examination of the several important items discussed above. Screens provided in the inlet piping should be cleaned regularly. The advantage of duplicate installations may be readily seen when continuous chlorination is mandatory, since one machine may be removed from service for either routine or emergency maintenance service.

The visible vacuum chlorine feeder maye be easily adjusted for feed rate, but the simplicity of the operation may be improved by a preventive maintenance schedule. Changes in feed rate are accomplished by raising or lowering a column of water which alters the rate of chlorine removal from the bell jar through the metering orifice tube. The device used to determine the height of the water column is referred to as the "adjustable riser." A silver tube, it is free to move through a packing gland, which must fit closely to prevent water or air leakage. The riser will move freely if the tube is kept polished and if gears and pivots in the

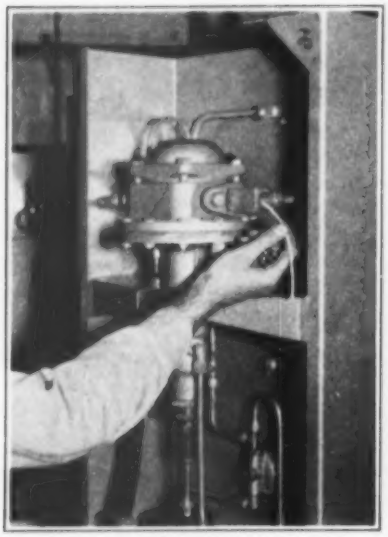


**Fig. 4—SPRING-LOADED chlorine valve**

Gas metering orifice being cleaned.

*Builders-Providence Photos*

**Fig. 5—CHLORINIZER rate setting by manual control**

Gas flow is visible in calibrated rotameter type metering tube.

adjustment mechanism are properly lubricated.

Experience will indicate what spare parts are essential to insure continuous availability of installed equipment. It is suggested the following items be stocked as basic to a spare parts inventory: vacuum relief float, bell jar, chlorine pressure reducing valve and float, orifice tube, metering tube, adjustable riser, injector throat, injector tail piece, packing and assorted gaskets.

## Vacuum Feed of Chlorine

### Visible Flow

Chlorine feeders of the visible flow type are characterized by the visible flow of dry chlorine gas through a rotameter, and by mixing the gas with water at an injector. The apparatus is connected to the chlorine piping system in such a manner that chlorine flow may be valved off when the feeder is out of service. Chlorine may be fed only when conditions of partial vacuum exist within the equipment and when all valves in the chlorine piping system are open.

There are several dispensers of this type presently available to the sanitation field. The basic principles of their operation will be discussed.

### Chlorinizer

The Chlorinizer* utilizes the vacuum induced by an injector to maintain a continuous flow of dry chlorine gas through a fixed metering orifice, rotameter, and bell jar. The chlorine gas is subsequently mixed with injector water for delivery to the point of application. Dosage control is accomplished by adjustment of a rate control valve which alters the pressure induced on the spring-loaded chlorine control valve (Fig. 4).

The control valve is in two sections, separated by a flexible tantalum diaphragm. The upper section, which reduces the chlorine gas pressure from relatively high to a partial vacuum, contains a needle valve upon which dosage control depends. The lower section, which contains water under pressure, provides the means by which the needle valve is adjusted. Any alteration of pressure in the lower section is transmitted by means of the flexible tantalum diaphragm to the needle valve in the upper section. The rate valve is controlled as illustrated in Fig. 5.

A calibrated rotameter type metering tube and float provide a visual means of flow observation. The metered chlorine gas remains dry until it passes into a bell jar, still under vacuum conditions, for delivery to the injector.

The bell jar mentioned above serves several useful functions: it encloses the metered gas, contains the chlorine gas draw-off pipe and a float-operated vacuum release which limits the amount of vacuum induced. The bell jar is suspended on a rod from the lower section of the chlorine control valve mentioned above, in such a manner that any interruption in vacuum conditions causes the needle valve in the upper section to react accordingly. Thus, the flow of chlorine to the metering component is stopped in the event of vacuum loss. A vent to outside atmosphere is also provided to remove chlorine vapor from the bell jar.

Routine preventive maintenance includes inspection of all threaded connections, tightening of all valve packing collars and keeping the metering tube and float clear at all times (Fig. 6).

Experience will indicate what spare parts are essential. It is suggested the following items be stocked as basic to a spare parts inventory: set of glass parts, spare rotameter tube and float, packing material, diaphragms and assorted gaskets.

### Ratochlor

The Ratochlor* utilizes the vacuum induced by an ejector to maintain a continuous flow of dry chlorine gas through a rotameter type measuring tube (Fig. 7). The metered gas is drawn into the ejector supply water for delivery as a water solution to the point of application. Dosage control is accomplished by the adjustment of a rate control valve which alters the flow rate from the rotameter.

Chlorine gas enters the dispenser from the chlorine supply system at pressures depending on the surrounding temperature. Pressure reduction and vacuum regulation are accomplished in a spring loaded regulator, the vacuum and atmospheric sides of which are separated by a flexible plastic diaphragm. Since the conditions of vacuum are closely regulated, chlorine gas is measured, then passes through the adjustable rate valve for delivery to a second regulator which

*Product of Builders-Providence, Inc., Providence, R.I.

*Product of Fischer & Porter Co., Hatboro, Pa.

has as its function the maintenance of a constant flow rate for any manual setting of the rate valve.

An atmospheric venting system is built into the apparatus to remove chlorine vapor from the internal system to outside atmosphere. Diaphragm failure in the spring loaded vacuum regulating device mentioned above will immediately shut off the gas flow. A pressure relief valve is included in the ejector assembly.

In the interests of metering accuracy, a clean metering tube and float are of basic importance.

Items basic to a spare parts inventory will be learned from experience; however, a spare rotameter tube and float, diaphragms and assorted gaskets should be on hand at all times.

#### Sterelator

In the Sterelator*, chlorine gas enters the upper valve chamber of the chlorine gas regulator and shut-off valve where pressure is reduced from that existing in the chlorine piping system (Fig. 8). The gas then flows under semi-vacuum conditions into the metering system through a throttling valve.

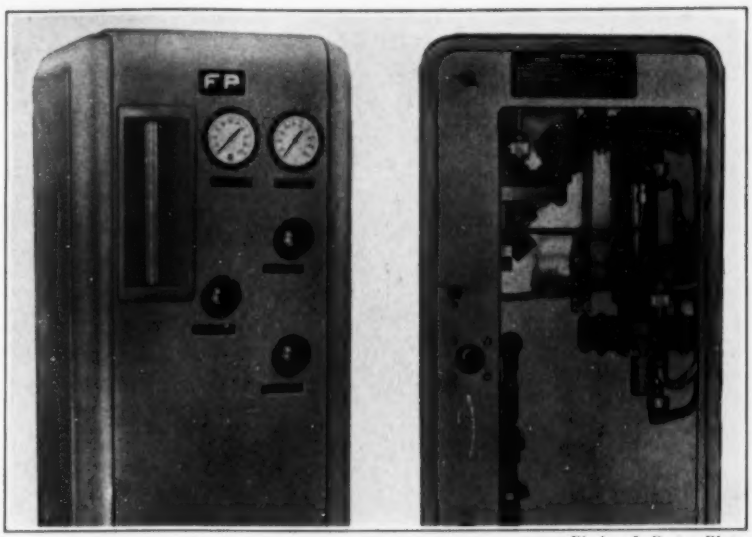
The metering component is a tapered tube rotameter type measuring device, calibrated to read directly in pounds per unit of time. Following the rotameter, the metered gas flows to a vacuum tower for delivery to the suction side of the vacuum-producing injector. The gas is removed from the upper end of the vacuum tower through a suction draft tube, which also removes sufficient water to satisfy the remaining demand of injector suction. The lower portion of the vacuum tower is immersed in a float controlled, constant level reservoir, which serves as a water seal between the metered gas and the atmosphere.

Safety features of the apparatus include a positive, spring actuated shut-off at the chlorine gas regulator and an hydraulically operated vacuum breaker which provides a vent to the outside atmosphere. The vacuum breaker is connected to upper as well as the lower end of the vacuum tower.

*Product of Everson Manufacturing Corp., Chicago, Ill.

*Builders-Providence Photo*

**Fig. 6—CLEANING the metering tube**
This is good preventive maintenance.




*Fischer & Porter Photo*

**Fig. 7—RATOCHLOR for visible flow vacuum feed of chlorine**
Rate control valve alters flow rate from the rotameter.

### Pressure Feed of Chlorine

#### Direct Feed

Direct feed equipment provides for metering dry chlorine gas and is installed in the piping system between the chlorine package and the point of application. The gas is not injected into a minor stream of water for eventual blending at the point of application; rather, the chlorine is conducted under necessary pressure conditions to the major flow of liquid being chlorinated.

The apparatus includes gauges for determining pressures in the chlorine piping system and within the device. Metering components of pressure feed devices may be either the rotameter or pressure differential (manometer) types, with provision for pressure compensation to insure measuring accuracy. Anti-flood protection should be provided to function automatically during shutdown periods or when excessive back pressure exists at the application point.

Maintenance of direct feed apparatus consists of regular inspection of the chlorine piping system, shut-off valve, gauges, control valve and all connections. The metering device should be kept clean at all times.

### Cleaning Procedures

It should be noted that the removal of chlorine residue from hard rubber floats and other portions of the feeding equipment is included in good housekeeping practices. While no perfect solution to the cleaning problem has been reported, the use of certain solvents—methanol (wood alcohol) and carbon tetrachloride—is suggested in addition to water and the time-tested scraping technique.

Caution must be exercised when employing the organic solvents, since a temperature rise (particularly when using methanol) may occur during the operation. The following procedure is recommended when cleaning chlorine feeder parts: Wash with water to remove water soluble material; wash next with a recommended solvent, using care to avoid breathing any fumes released; thoroughly rinse free of solvent and dry completely before replacing the parts for service.

It is pointed out that use of methanol and carbon tetrachloride as cleaning solvents avoids the possibility of forming undesirable chloro compounds if insufficient rinsing is accomplished since methanol oxidizes to carbon-dioxide and water and carbon tetrachloride is the product of chlorinated methane; however, good practice indicates thorough water rinsing followed by air drying.

Common practice has been to scrape the dry residue from the outer surfaces of hard rubber components of feeding machines. Sharp instruments, such as knives or razor blades, to-

*Everson Mfg. Corp. Photo*

**Fig. 8—STERELATOR chlorine feeder, visible flow vacuum type**
A rotameter is the gas measuring device employed.

gether with abrasives, sand paper and steel wool must be used carefully to avoid possible injury to the equipment. When the scraping procedure is followed, caution should be observed to avoid inhaling the dusty residue.

### Chlorine Hydrate

The formation of chlorine hydrate in some chlorine feeders, commonly referred to as "chlorine ice," results from high concentrations of chlorine subjected at reduced pressure to temperatures below 49.2° F. Faulty feeder operation or poor chlorine quality are not the cause of this condition, which may interfere with metering accuracy or adequate vacuum relief. The solution to this problem is to raise the temperature of the affected area or warm the influent chlorine gas. By far the safest method is to warm the affected area by adding warm make-up water. It is possible to warm the influent gas, but extreme caution must be exercised; guidance in this operation should be obtained from the chlorine supplier or equipment manufacturer.

### Automatic Control

Chlorinating equipment has been developed which enables automatic control of chlorine dosage. Accessories are available which will vary the feed automatically proportional to the flow of the liquid being chlorinated, or will effect intermittent chlorine dosage where desired.

### General Suggestions

Close attention should be paid to all portions of the chlorine piping system and feeding equipment for evidence of gas leakage. Inspection should be made of all threaded connections and valves, and should include prompt corrective action for leaks. Packing glands tend to dry out and should be replaced at regular intervals.

Leakage in water piping and valves should also be eliminated, if for no other reason than conservation. External condensation on water lines can be the cause of expensive pipe replacement and would indicate the need for protective paint application.

Vents to the out-of-doors are frequently overlooked in routine maintenance schedules. It should be noted that vents to the atmosphere constitute important safety devices. The possibility of water entering vent lines, thus serving as a trap, must be eliminated. Freezing or plugging with foreign material must be avoided.

### Acknowledgments

The author desires to express appreciation to those many individuals whose cooperation has made this article possible. The manufacturers of chlorine feeding equipment and their technical representatives especially have contributed helpful advice and criticism, as well as the photographs used for illustration.

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T. E. Larson

C. C. Larson

## A Correction—
## Larson (T. E.) and Larson (C. C.)

Above we correctly identify two Larsons—one of whom was incorrectly labeled in our report of the Illinois Section meeting (June issue, page 224). Our apologies to Larson and Larson for the confusion.

T. E. Larson is Head of the Chemistry Sub-Division, State Water Survey, Urbana, Ill.

C. C. Larson is Chemist and Supt. of Water Purif., Water, Light & Power Dept., Springfield, Ill.

## Lubrication of High Temperature Bearings*

**A Method Learned from an Expert**

In discussing lubrication problems with an internationally known lubrication expert not long ago, he informed me of interesting instances where he does the diametrical opposite of what is commonly done in lubrication, namely, he adds lubricant on *stopping* the drive instead of when *starting* it. He doesn't merely add a few drops with an old can; he turns on a sight feed oiler.

He explains to me that he resorts to this method only in connection with the lubrication of ball and roller berings where the bearings are adjacent to a source of high temperature.

I asked, "Why do you do it in that way? Is it for the purpose of adding a new supply of oil, or, does the oil serve as a coolant?"

"No", he informed me, "I do it in order to kep the grease from hardening. If the oil were applied directly to the grease while the motor is in motion it would not have a chance to be absorbed by the grease because centrifugal force would cause the oil to throw. In this manner I have been successful in taking care of surprisingly high temperatures."

Sounds like good logic, doesn't it?

*Contributed by W. F. Schaphorst, M.E., Newark, N.J.

# REPORT FROM ABROAD

## Alternating-Double-Filtration Has the "All Clear" Signal in Great Britain

*by* **JOHN FINCH**, *Manager, Sewage Disposal Department*
*Rotherham, England*

THE rate of progress being made by the alternating-double-filtration process of sewage treatment in Great Britain is proving to be of interest to technicians in the sewage treatment field not only in Great Britain but far remote from the British Isles, and the pioneers constructing plants of this type are being given their due share of close scrutiny.

The report on "Water Pollution Research—1951," compiled by the British Water Pollution Research Board of the Department of Scientific and Industrial Research, directed the thoughts of many sewage treatment authorities to the alternating-double-filtration process as a secondary cycle in modern sewage treatment practice. The findings of the Water Pollution Research Board on further aspects of the problem have added to the growing fund of information on the subject in general.

### Two Pioneers Developed Alternating-Double-Filtration

Recent events indicate it is not commonly appreciated that the process of alternating-double-filtration should be credited to the great Birmingham pioneers, F. R. O'Shaughnessy and H. C. Whitehead—the former discovered *the process* and the latter devised *the application*. The process was based on O'Shaughnessy's observation that a filter clogged with biological growth would clear if it was dosed with a partially purified sample of sewage; and that the growth soon would become dispersed.

Dr. S. H. Jenkins of the Birmingham Tame & Rea District Drainage Board, in some recent correspondence published in a technical journal, points out that O'Shaughnessy suggested the application of this fact in experiments carried out at the Colwick sugar beet factory for the Water Pollution Research Board. As a result of these investigations and observations, Whitehead, the Engineer to the Birmingham Tame & Rea Board, designed two percolating filters to operate alternately on beet sugar wastes and primary effluent so as to obtain one filter that was clogged and to demonstrate the cleaning action of primary effluent on the clogged filter. The experiment was not conclusive because the primary filter would not clog and because the final effluent was of poor quality.

Investigations on the purification of milk factory wastes were undertaken by the Water Pollution Research Laboratory in 1933. As is well known these wastes cause heavy surface growths on percolating filters, due to the removal of fat and solids and to the extremely rapid growth of organisms on the milk solids. Dr. Jenkins states that, working independently at Birmingham, O'Shaughnessy found that this growth could be almost completely removed by feeding the filter with good effluent from a similar filter. Subsequently, Whitehead designed an experimental plant to operate on the alternating-double-filtration principle in order to prevent excessive growth on the surface of the filters, and only after an operating period of two years on milk wastes was it realized that this method of oxidation provided a means of increasing the performance of a percolating filter plant.

Subsequent investigations by the Water Pollution Research Board published in 1941 showed that a rate of application twice that of single filters was practicable, and at a later date this rate of flow was increased to four times that used by single filtration.

### Birmingham Was First to Use the Process

Dr. Jenkins thus placed on record a concise and informative historical sketch of the discovery and development of the alternating-double-filtration process. The Birmingham Tame & Rea District Drainage Board were the pioneers and have had the courage of their convictions to install the process as the first part of a gradual changeover at the Minworth sewage treatment plant. For many smaller authorities, this move constitutes the "all-clear" and points the way to further development of a system which has now been accepted in many quarters of the sewage field.

The process of alternating-double-filtration was thus conceived at Birmingham; has been carefully nurtured and developed to a large extent at Birmingham, and that same authority is now one of the first to make practical use of the principles involved. It is hoped that, in the near future, the Birmingham workers will publish a report of the practice of alternating-double-filtration with the plant already converted at Minworth.

Several other authorities have also accepted the doctrine and are either intending to construct, are constructing, or have constructed schemes of this type, and included in the list are the authorities, Bedford, Northallerton, Norwich, etc.

### New Bedford Plant

An example of such a scheme is the recently completed extension to the sewage disposal works at Bed-

Mr. Finch's *Report from Abroad* will continue to present facts, observations and opinions of timely interest. The author is Chairman of the North Eastern Branch of the Institute of Sewage Purification, and is a frequent contributor to British technical journals. He will welcome the opportunity of replying personally to readers of *Water and Sewage Works* who have questions or require additional information regarding the subjects discussed.—The Editors.

BIRMINGHAM—New filters and settling tanks under construction

ford which extension has included the construction of an alternating-double-filtration plant capable, so it is said, of treating an average daily dry weather flow of 2.5 mgd. The alternating-double-filtration plant is believed to be the first new works of its kind of comparable size, and a number of engineering problems have had to be solved in carrying into effect the rather complicated requirements. It is stated that by employing alternating-double-filtration, the rate of dosage on the percolating filters may be increased to about two and a half times that possible with ordinary double filtration.

### Bedford Can Evaluate Three Types of Filtration

Existing filters at the Works are remaining in service and will provide ordinary two-stage filtration for a dry weather flow of 1.1 mgd. It would appear that the rate of flow onto these old filters will be at about 65 to 70 gallons per cubic yard per day, but as there are no details in the Bedford report as to the analysis of the sewage being treated, it can only be assumed from the above rate of application that the sewage is in the "strong" category, having an oxygen absorbed figure of the order 110-140 ppm, and a B.O.D. of around 400-500 ppm. It is rather a pity that the loading data for the design of the new scheme are not included in the Bedford report, as this would have made the report of greater value to the other workers in the sewage treatment field. As it is, it become an exceedingly difficult task to assess the efficiency or otherwise of the alternating-double-filtration plant due to the non-inclusion of this vital information in the report. Perhaps at a later date when the plant has been in operation for some time, the Bedford authorities will publish the operating results of the scheme so that the blanks in the story of alternating-double-filtration at Bedford may be filled in.

Incidentally at this plant it will be possible by virtue of the layout of the existing equipment to compare the performances of three types of filtration by percolating filters: i.e., conventional single stage filtration (the primary section of the existing two-stage process), two-stage filtration as intended to operate with the existing old filters, and alternating-double-filtration with the new installation. It is not often that such an opportunity as this exists on one sewage treatment plant, and a report giving comparative results from this installation will be of the greatest value as a technical contribution to the art of percolating filter treatment, and will constitute a "good neighbour" policy much appreciated by other authorities seeking just such data.

### Early Bedford Works

The old sewage treatment plant at Bedford was constructed on the present site just prior to the 1914-18 war, but was not brought into commission until 1918, when the population of Bedford was about 40,000.

Designed for a daily dry weather flow of 1.6 mgd, the plant included grit tanks, primary settling tanks, primary and secondary filters, each with its own humus settling tanks.

By 1944 the population of Bedford had risen to 51,000 and the daily dry weather flow had risen to 2.6 mgd. It was therefore very essential to rebuild the works, which at that time had been overloaded for some years.

In planning the new sewage treatment plant, it was decided that provision should be made to treat ultimately a flow of 3.6 mgd which, at a water consumption figure of 45 gallons per head of population, would provide for 80,000 persons or equivalent. The population of Bedford is now 54,000 and sewage from outlying districts is being conveyed to the sewage treatment plant; and further sewerage schemes are anticipated in the near future which also will drain to the extended treatment plant.

A point of interest in the construction of the new works is that by undertaking to treat the sewage of adjoining areas the Bedford Corporation seek to prevent any pollution of the River Ouse (which might arise from the construction of other sewage treatment schemes upstream of the water intakes of the Corporation Water Works). The Corporation supplies water from the River Ouse, immediately below Clapham, to a large area of North Bedfordshire.

### New Bedford Works

In the year 1944, Bedford Corporation consulted the late Mr. H. C. Whitehead, then Engineer to the Birmingham Tame & Rea District Drainage Board, and after his death, Mr. J. M. Wishart, as to the nature of any extensions which should be undertaken. Both Mr. Whitehead and Mr. Wishart, as civil engineer and chemist respectively, advised that extensions should be carried out along the lines of alternating-double-filtration. Following discussions with the Ministry of Health, the scheme was approved in outline and permission to carry out the work was obtained in due course.

At Bedford, the arrangement of filters for alternating-double-filtration had to comply with the following requirements:

1. Each filter should be capable of being connected either as a primary filter or as a secondary filter.

2. The filters were designed to deal with 200 gallons per cubic yard of filtering medium per day, and when the filters are in series, the rate through each filter is thus 400 gal. per cu. yd. per day.

The rate of flow may rise to three times the dry weather flow in times of rain; under these conditions it would be necessary hydraulically to pass the settled sewage through the filters at the rate of 1200 gal. per cu. yd. per day. However, the filters are placed in parallel and provide single stage treatment only when the flow increases above the one-and-a-half times the dry weather flow; thus the rate through any filter would not exceed 600 gal. per cu. yd. per day.

A pertinent question which is asked on many occasions by sewage technicians interested in alternating-double-filtration, relates to the treatment of sizable overloads (both in volume and strength) in times of storm and on other occasions; the effects of these overloads on the filter plant; and the effects on the final effluent from the plant.

Take, for example, a case in which I happen to be familiar with the actual works conditions:

At this particular plant, in times of storm reaching a certain intensity of rainfall, considerable volumes of strong undiluted raw sewage are swept along the combined outfall sewers ahead of the stormwater. This flow, along with very potent sewer scourings, presents a problem at the sewage treatment plant, where for a short period of time an overload varying between 50 and 200 per cent presents itself in no uncertain manner for immediate attention. Should this set of conditions chance to happen at the diurnal maximum flow in dry weather, when the rate of flow to the sewage treatment plant is approximately twice the average flow (no unusual state of affairs in Great Britain) then it will be readily appreciated that an embarrassing situation can very easily develop, not entirely covered by the installation of a balancing tank.

Would this type of overload be taken care of by alternating-double-filtration, or would the resulting effluent from the treatment of such sewage be inferior and perhaps unsatisfactory for a period of time? Furthermore, at the time when the changeover from series to parallel working is made at the 3 times dry weather flow conditions, would the effluent from the filters in parallel be inferior to the conventional or alternating-double-filtration method of working?

Returning to technical details of the Bedford scheme: the installation includes four new circular settling tanks 75 feet in diameter with a total detention period of 9 hours average dry weather flow; six new filters 109 feet in diameter by 6 feet deep having an aggregate volume of 12,385 cubic yards of material; two new circular primary settling tanks 46 feet in diameter with a total detention period of two hours at dry weather flow; and four new circular secondary settling tanks with a detention period of 3 hours at dry weather flow. A venturi tube is used to measure the rate of flow and thus to control the automatic changeover between series and parallel working. As the plant is designed, recirculation of effluent may be introduced, the liquid being mixed with the settled sewage prior to being passed to the filters.

In a further article, it is intended to give some details of the automatic operation of the Bedford plant, as these may be of interest to engineers evaluating this type of treatment.

## "Steve" Rankin Next "Prexy." of W&S Wks. Mfgrs. Assn.

R.S. "Steve" Rankin, Sanitary Eng. Div. Sales Manager for The Dorr Co., was elected president of the Water and Sewage Works Mfgrs. Assn., during its annual meeting in Grand Rapids, Mich. Mr. Rankin, now vice-president of the Association, will take office as president on Jan. 1, 1954, for a one year term.

Harvey S. Howe, vice-president of the Lock Joint Pipe Co., was elected vice-president of the Association, to take office Jan. 1, 1954.

Hubert F. O'Brien, president of the A. P. Smith Mfg. Co., was re-elected treasurer of the Association.

The following member firms were elected to the Board of Governors of the Association for a term of three years:

*Chicago Bridge & Iron Co., Chicago.
*Hydraulic Development Corp., N.Y. City.
Pacific Flush Tank Co., Chicago.
Pittsburgh Equitable Meter Div., Pittsburgh.
*U.S. Pipe & Foundry Co., Burlington, N.J.

*Re-elected for second three year term.

## H. E. Moses New Chairman Ohio River Valley Sanitation Comm.

Howard E. Moses, who took office on July 8 as chairman of the Ohio River Valley Water Sanitation Commission brings to this post the viewpoint of a public-health administrator who has had a continuous record of 45 years service to the Commonwealth of Pennsylvania.

As chief engineer and director of the Pennsylvania bureau of sanitary engineering, Dr. Moses has had supervision of public water supplies serving 8,000,000 people and has played a major role in the management of his state's stream pollution-control program. He was one of the participants in the negotiations that led to the formation of the 8-state compact commission for pollution abatement on interstate streams.

Dr. Moses joined the Pennsylvania State Health Department ten years after his graduation from Dickinson College in 1898. All of his activities have been related to the application of engineering to environmental sanitation problems including bathing beaches, shellfish harvesting, flood and catastrophe services and civil defense. Currently he is chairman of the Conference of State Sanitary Engineers.

Active in many professional and technical organizations devoted to sanitary engineering, Dr. Moses' contributions have been recognized by awards from the American Water Works Association and the Federation of Sewage and Industrial Wastes Association. He holds an honorary degree of doctor of science from Dickinson College.

**Beware Disappointment!**

Those things for which we sit down and wait oftentimes have little resemblance to that which was waited for.

# SEWAGE WORKS PRACTICES

## OPERATION • MAINTENANCE • MANAGEMENT

# Grit Chambers—Their Function, Operation and Control

**The Fourth of a Series**

*by* **DON E. BLOODGOOD**, *Professor of Sanitary Engineering*
*Purdue University, Lafayette, Ind.*

THERE have been a few sewage treatment plants designed and built that do not have grit chambers, and in many of these instances the operator of the plant has been very unhappy about his situation.

It was formerly the opinion of some designing engineers that if a community had a separate sewer system there was little need to provide a means for removing grit. They believed that if storm drainage could be eliminated from the system there would be little need to remove cinders, sand, and similar materials from the sewage. It has been found, however, that considerable material of the gritty type does get into even sanitary sewers.

Some of it may come from imperfections in sewer joints, dirty waters from homes, wash racks at filling stations, and from particular industrial wastes that have not been given pre-treatment before discharge to the sewer system. There are materials from the home such as egg shells, bone chips, coffee grounds, and pieces of fruit pits that behave as grit in sewers. If boiler room floors are flushed down in cleaning, the result may be that some cinders get into the sewage. One unusual source of grit reported was the finely broken glass from a plant processing broken glass.

The quantity of grit that gets into combined sewer systems varies from city to city. The reason for this may be that one city may have many more unpaved streets and alleys. In some cities there are no catch basins at street corners, or if installed, they are not properly maintained, so that when it rains the grit is flushed directly into the sewers.

There are differences of opinion on just how the grit is transported in the sewers. Some believe that it is held in suspension and is carried by the water; others believe that the grit is rolled over and over on the bottom of the sewer. It is probable that both methods of movement are taking place, but if one will watch the waves on a lake shore where the water is clear, the sand on the bottom can be readily seen rolling over and over. There may be a similar movement of grit in sewers.

### Purpose of Grit Chambers

Sand, cinders, and earth are often thought of as rather inert materials that are found in nature and can be disregarded. They do not decompose and therefore should not be difficult to handle, or even to dispose of. This raises the question about the need for special facilities to remove these materials from sewage.

There are other materials in sewage that have the general characteristics of grits; that is, they have sufficient weight so that they settle quickly in water and some of them are sharp and hard. Grains, seeds, and larger pieces of fruit rind are examples of different types of organic matter found in grit. Some grit contains appreciable quantities of all types of organic matter. Grit, therefore, is objectionable when it settles in unwanted places and when it is abrasive and grinds away metal parts of equipment.

Sewers should be designed so that the velocity of flow in them is such (about 2.0 feet per second or more) that the grit is moved along and is eventually delivered to the sewage treatment works. It is very desirable that the sewer or sewers entering the sewage treatment plant discharge directly to the grit chamber without any prior treatment or handling. However, when the layout is of this type, there is a possibility that the large lighter materials (removable by racks) will be deposited in the grit chambers—and *this* is not desirable. No matter which way your plant is laid out, it is safe to venture that you will wish that it was of the opposite design!

### Grit is Abrasive

Grit is very hard on pumping equipment. In a number of plants where the grit has not been removed before the sewage was pumped, the result has been the complete destruction of the inside parts of sewage pumps. Grit grinds away metal about as rapidly as does grinding compound used for lapping in valves on a gas engine or for sharpening a lawnmower. If all gritty particles could be removed from sewage, the wear on mechanical equipment exposed to the sewage would be very much less.

Grit is sometimes found deposited in wet wells ahead of sewage pumps if the velocities in the wet wells (sumps) is not sufficient to keep the grit in suspension until it can be removed. It would seem that grit chambers should be installed before sewage is pumped. In some instances this has not been feasible, particularly when the sewers are far underground and the operation of a grit chamber in such a location is almost impossible. Lifting grit from a chamber located

In this series, Professor Bloodgood discusses *Sewage Works Practices* in the form of simple short course lectures. Each article is designed to interest and assist plant operators, students, and all who wish to review fundaments in this field.—The Editors

twenty feet or more below ground level is a very difficult task, and the job is likely to be shirked if there is opportunity to do so.

### Grit in Primary Sludge

One might well ask why grit should not be removed along with primary sludge in a primary sedimentation tank. The person who is best able to answer such a query is the operator who has had a primary settling tank sump and discharge line completely stopped with the grit that passed through a grit chamber in need of cleaning. Such stoppages usually are removed by taking the primary settling tank out of service, removing the water by portable pump (a difficult job in itself), laboriously digging out the grit from the sump, and hoisting it by hand out of the primary tank.

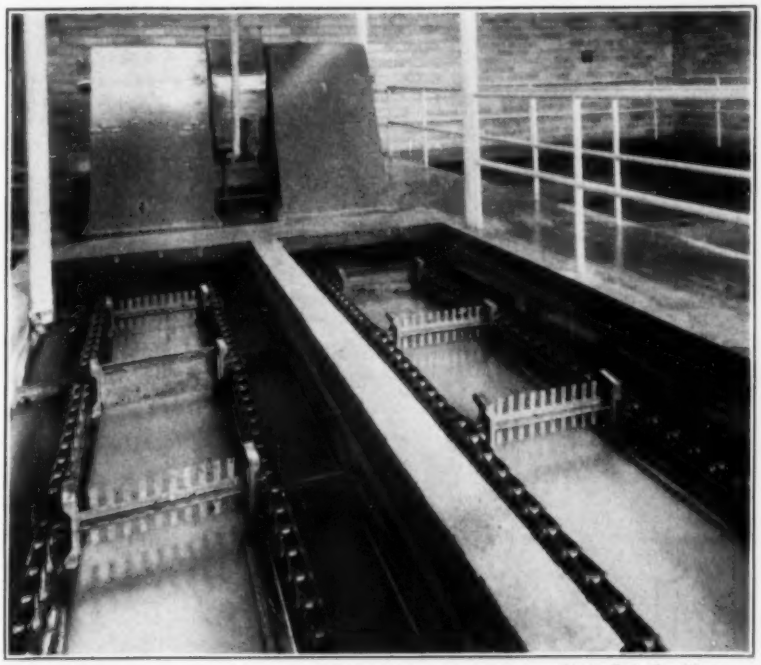
An operator may be fortunate enough to have primary tanks so installed that stoppages of lines are not possible or do not happen. Then the grit that passes through an improperly operated grit chamber may find its way into the sludge digestion tanks, where it has time to settle and accumulate in the bottom of the tank. Eventually it will be necessary to remove grit from that location. Removing grit from digestion tanks is no happy experience and is not a job that can be contemplated with any pleasure.

Grit in primary sludge puts unusual wear on the pumps used for moving the sludge. When grit is present in primary tanks it causes unusual wear on the sludge removal mechanisms in the tanks. The grit sometimes serves as a grinding compound between the rails in the bottom of the tank and the shoes of the sludge removal mechanism.

If grit could be removed from digestion tanks with the sludge, there is no reason why it should give trouble on sludge drying beds; in fact some sewage plant operators use washed grit to make up for the sand lost when sludge is removed from sludge drying beds.

## Types of Grit Chambers

In some text books grit chambers are classified into groups: (1) those that are cleaned by hand, and (2) those that are mechanically cleaned. Actually, however, there are many, many types of grit chambers and grit handling equipment. In fact, even an experienced person visiting a treatment plant sometimes has difficulty understanding the operation of grit removal equipment; even though the grit is being discharged in a perfectly obvious place.



*Chain Belt Co. Photo*

**Fig. 1—GRIT CHANNELS with duplicate grit collector units, Manitowoc, Wisc.**

The differences in construction of the units, however, does not alter the purpose or the method of removing grit from sewage. All grit chambers in use today, employ the principle of slowing down the rate of flow of the sewage so that the grit has time to settle out. Different designs have been developed for the purpose of controlling the velocity so that the grit is removed, and also for the purpose of producing a grit that has a minimum of organic matter in it.

### Design of Grit Chambers

The simplest grit chambers are channels just a little larger in cross section than are the sewers leading to them. The grit chambers of this type are usually installed in pairs so that one channel at a time can be taken out of service and cleaned. The rate of flow in the so-called rectangular grit chamber can be controlled by: (1) gates that must be opened and closed as the flow changes; (2) weirs designed to give a constant velocity in the grit channel regardless of the flow; or (3) flumes at the end of the channel that also control the velocity in the chamber and maintain it at approximately one foot per second regardless of the flow.

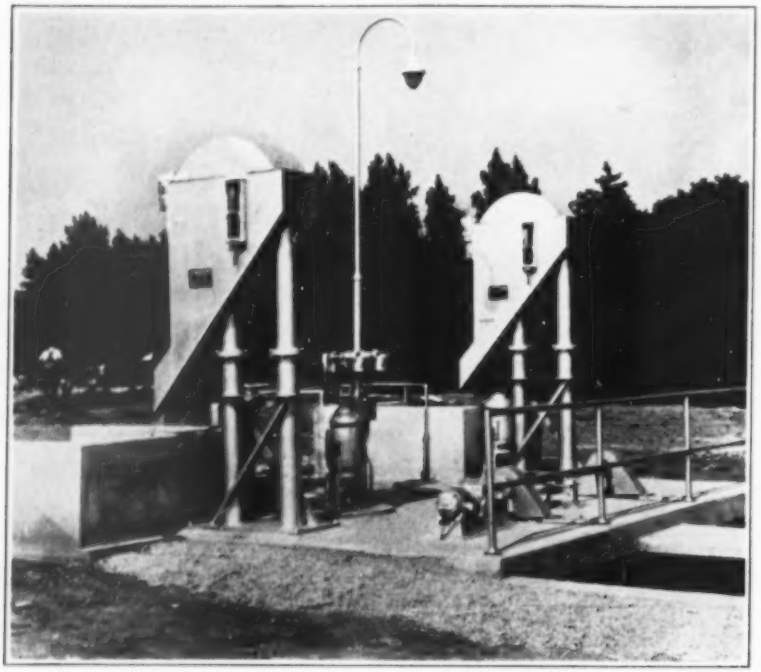
There are grit chambers that are combined with coarse bar mechanical racks. These installations include buckets for grit removal and rakes to clean the racks.

There are special tanks designed for the removal of grit. Some of these are square and little if any attempt is made to control the velocity through them. The intent is to keep the velocity so slow that all the grit is certainly removed. Removal of the organic matter from the deposited material in these units is accomplished by separating the organic matter and passing it on to the sewage treatment processes. The separation of the organic matter may be accomplished in the grit tank, or the mixture of deposited material may be removed and the separation accomplished by hydraulic means.

The aerated grit chamber has been used in some instances. In most units the grit is removed along with a large volume of sewage. The grit is settled out and the sewage returned to the sewage plant for further processing. The amount of air used is sufficient to keep the organic solids in suspension, but also to permit the heavier grit to settle. There are grit chambers that have odd-shaped cross sections so that regardless of the quantity of flow the velocity through the chamber remains the same.

## Grit Chamber Operation

There has been little information published about the operation of grit chambers. Most writers have dealt primarily with the design of the units. It is true that if the ideas back of the design for a particular grit chamber are thoroughly understood, then the operation of that installation should be easier.



*Am. Well Works Photo*

**Fig. 2—GRIT ELEVATOR and Hydrowash units, LaGrange, Ga.**

For those who wish to study the theories and methods of design, the work of Camp (1) is highly recommended. One of the best discussions on grit chamber operation has been presented by Hay (2). Keefer (3) has compiled data on the quantities and characteristics of grit.

A grit chamber that has no velocity controlling devices is rather difficult to operate because, as you well realize, there are great fluctuations in the rates of flow received at a sewage treatment plant. It would be foolish to suggest to the operator of a small plant that each hour of the day he should determine the sewage flow and then set the control gates so that just the correct velocity was attained in the grit chamber. This would be particularly difficult for the operator whose plant is not equipped for measuring the incoming flow. In cases of this kind the operator should seek assistance in determining the maximum flow permissible for his grit removal unit. He should then establish the proper gate settings so that the required velocity of one foot per second is secured at times of maximum flow or highest velocity.

In this way it will be possible to deposit all the grit at maximum flows, but probably at minimum flows considerable organic matter will be deposited. The extra organic matter may not be a problem in the small plant because the small quantity of grit and organic matter can be quite easily buried. The important objective in grit chamber operation is to prevent any major quantity of grit from getting into the plant and causing the difficulties previously mentioned.

## Need for Measurement of Deposited Grit

Adjustments of flow rates are not as easy as one might expect. As the grit chamber fills with the deposited grit the cross-sectional area of the chamber is reduced, and this change will increase the velocity through the chamber. The result may be that some grit is carried through and into the plant. It is, therefore, essential that the accumulation of grit be determined quite often in order to know when the grit channel should be cleaned.

In normal operation, measurements of deposited grit will not show much of a daily variation; however, if a rain occurs, a grit chamber (that on the previous day has seemed to not need cleaning for several weeks) may need to be cleaned immediately after the rain. Rain that brings high flow rates and velocities in sewers can be expected to bring unusual quantities of grit into the treatment plant.

It would appear to be a waste of time to measure the deposited grit every day during a dry summer period; but, unless a definite schedule of measuring the deposited grit is set up, it is very easy to forget to do it and then troubles with grit in other parts of the plant are the consequence. A schedule for grit measurement of once each week may not be satisfactory in all instances, but as a general rule it will be all that is required. The records of these measurements should be kept on the monthly report sheet and it is a good idea to make the measurements on the same day each week so that it becomes a regular procedure.

The grit is usually deposited at an uneven depth throughout the length of a grit chamber. The greatest accumulation will be found at the head end or entrance end of the chamber. The point or points for measurement of grit depth must be properly selected. In some plants operators measure the grit depth at the beginning, middle, and end of the channel. When the depth of grit at the middle point approximates the depth at the head end, some operators then say that it is time to clean the channel. This is a satisfactory standard in most instances. Certainly a channel should be cleaned when there is a measurable deposit at the end of the channel.

## Cleaning Grit Chambers

Where there is more than one grit chamber in a plant, the problem of cleaning is simplified. The channel to be cleaned can be enclosed: that is, the influent and effluent ends may be shut off by sluice gates or stop planks.

Cleaning is simplified when the excess water can easily be drained or pumped from the channel prior to the removal of the grit. Removal of the water is not absolutely essential if the grit can be removed by scooping or shoveling. The extra work required in lifting water with the grit may be less than that hequired to get rid of the excess water.

In plants where there is only one grit chamber, the problem of cleaning becomes more complicated. Removal of grit while sewage is flowing through the channel causes stirring of the deposited grit, and may result in most of the grit being flushed on into the other parts of the plant.

No one method of cleaning is best when sewage is flowing through the channel, because a method satisfactory for some installations might be just the wrong thing to do in others. It may be said that generally the channel should be cleaned during a period of low sewage flow (but not necessarily must it be cleaned at night when the flow is the lowest). It is essential to have the velocity in the channel much less at the time of cleaning than it is during normal operation. The slowing of the velocity can be accomplished by increasing the depth of water in the channel. This can be done by

partly closing gates at the outflow end of the grit chamber, or by placing a dam at the outflow end so that the depth of sewage in the channel is materially increased.

### Removal of the Grit

With these preparations for cleaning made ,there remains the task of removing the grit by means of dipping, shoveling, or hoisting. Many attempts have been made to ease the hard work of removing grit. Engineers and equipment designers have been successful in developing drags, air lifts, etc., to facilitate in the removal of the grit.

Hand removal of grit from small channels is hard work, but the good operation of cleaned grit chambers pays off in the long run. The grit chamber should be considered a very important unit of the sewage plant.

The mechanism of some mechanically cleaned grit chambers is operated by time clocks that can be set to operate at specified time intervals. In other installations, the mechanism is operated at the will of the operator. It is not possible to say how often the grit removal mechanism should be operated. It can be said that it would be a very rare case where the mechanism should be moving all the time. A general rule to follow is that the mechanism should be run only long enough to remove the amount of grit accumulated since the last time of operation. Note that this rule did ated until *all grit* is removed from the not say that the mechanism is operchannel.

The mechanism of mechanically cleaned channels should certainly be operated once each day. In some cases, the channels are cleaned on a schedule of three times per day except at times when storm water is being received; then the mechanism may be operated as often and as long as necessary to keep grit removed from the channels.

The material removed from grit chambers may be almost as free from organic matter as the sand obtained from a gravel plant, or it may be nearly all organic matter. The nature of the grit determines the method which is satisfactory for its disposal. Of course, the quantity of grit obtained is another factor in determining what the disposal method should be. If the quantity of grit is in the neighborhood of a wheelbarrow load per day, the task of disposing of it is not very troublesome. If the quantity removed amounts to a truck load or more, considerable care must be used in dumping.

Grit that is buried usually causes no difficulty. Sometimes troubles encountered when grit is placed on a dumping ground can be minimized by sprinkling the deposited material with lime. Operators who have received complaints about bad smelling grit are appreciative of grit removal equipment designed to produce a grit free from objectionable organic matter; this equipment produces a grit that can be deposited or used almost anywhere that fill of sand-like material is required. Some few sewage treatment plants have equipment for the incineration of the material removed from grit chambers. The end product from incineration, of course, causes no particular disposal trouble.

**Fig. 3—GRIT REMOVAL by clam bucket. Covered grit chamber, Indianapolis, Ind.**

## Analysis of Grit

In some instances it is extremely desirable to have knowledge of the nature of the material removed from grit chambers. Whether or not the odor of grit is objectionable is perfectly obvious.

The determinations commonly used to evaluate grit are those for moisture, volatile matter, ash, and nitrogen. None of these gives a positive evaluation of the grit, but one or all of them when made regularly will tell when there are changes in the quality of grit. The great problem in grit analysis is not to perform the test, but in obtaining a satisfactory sample. It is most difficult to get a representative sample of grit. To get a good sample, it does not suffice to take a few ounces from one load or container; it is necessary to take a small amount of sample from portions of all material removed.

One test developed for the evaluation of grit is called the Daisy Churn Method. The principle of the test is to measure the organic matter that can be washed out of grit. This *laboratory* method of washing grit gives a fairly good idea of the nature of grit that can be produced in the *plant* by washing of grit from the grit chambers.

### Summary

No attempt has been made in this article to tell a plant operator the normal quantity of grit that he should expect or the analysis of the material. It is assumed that if the quantity of grit received at a plant is a serious problem, the operator will take steps to determine where the grit comes from and, if possible, to do something about decreasing the amount getting into the sewers.

The general principles described in this article may be applied to produce a grit that contains less organic matter and thereby reduces the problem of disposal. Grit chamber control is very important in the successful operation of a sewage treatment plant.

#### References

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2. Hay, T. T., Experience in Grit Removal and Handling at Racine, Wisconsin, *Sewage Works Journal*, Vol. XVIII, No. 1, pp 54-65 (January 1946)

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# Safety in Sewage Works Maintenance and Operation

**The Second of a Series**

*by* **LEROY W. VAN KLEECK**, *Prin. Sanitary Engr., Conn. State Dept. of Health, Hartford, Conn.*

THIS installment continues our discussion of employee safety in sewers. It is devoted to descriptions of hazardous conditions and characteristics of gases encountered in sewers.

Sections A and B of Part I appeared in the July 1953 issue of *Water & Sewage Works*.

Section C

## Dangers from Noxious Gases and Oxygen Deficiency

Before proceeding, a few definitions are needed:

### A Gas

A gas is a state of matter in which the movement of molecules is practically unrestricted. Gases have neither definite shape nor volume, and are thought of as anything of an invisible nature other than air (air is a mixture of gases).

### Vapor

A vapor is the gaseous phase of a substance which can exist also in the form of liquid at common temperatures and pressures. Water vapor and gasoline vapor are examples.

### Noxious Gas or Vapor

A noxious gas or vapor is any gas or vapor that is directly or indirectly injurious or destructive to the health or life of human beings. The presence of such noxious gases or vapors may present a hazard by causing burns, explosions, asphyxiation or poisoning. It is important to bear in mind that a gas may asphyxiate a human being by the mere action of replacing or excluding the oxygen necessary for life in an atmosphere. Thus, nitrogen, methane (also known as marsh gas) and hydrogen are in themselves non-poisonous, but when breathed in sufficiently high concentrations they asphyxiate *mechanically* by excluding oxygen.

### Sewer Gas

Here we have a misnomer: Sewer gas is not a single substance, but a mixture of gases resulting from the decomposition of deposited organic matter in sewers. The conditions producing it result from sewer stoppages or sewers laid on too flate a grade. An atmosphere containing so-called sewer gas contains an abnormally high percentage by volume of carbon dioxide, varying amounts of methane, hydrogen and hydrogen sulphide and a low percentage of oxygen. The hazard created usually is because of an explosive amount of methane or a deficiency of oxygen, usually the latter.

### Oxygen Deficiency

Normal air contains about 21 per cent by volume of oxygen and about 79 per cent by volume of nitrogen. There are traces of other gases. Atmospheres containing less than 13 per cent by volume of oxygen are decidedly dangerous to human beings.

### Explosive Range

Flammable* (burnable) gases must be mixed with air (oxygen) in certain proportions before an explosion will occur.

## Explosive Conditions

No explosion is possible unless four conditions exist:

1. Presence of a flammable gas.
2. Presence of air (oxygen).
3. A mixture of (1) and (2) in the proper proportions.
4. A source of ignition (open lights, sparks, hot filaments, etc.).

Every flammable gas or mixture of such gases has a lower and upper explosive limit based on the percentage by volume of the gases with air. *Between these limits* flame will propagate throughout the mixture, causing an explosion.

The minimum concentration of a gas-air or vapor-air mixture which propagates flame, if ignited, is known as the lower flammable or explosive limit. It is the leanest mixture with air that will explode.

The maximum concentration of a gas-air or vapor-air mixture which, if ignited, propagates flame is known as the upper (higher) flammable or explosive limit. It is the richest mixture with air that will explode.

Mixtures of flammable gas or vapor with air below or above these limits will burn as long as they are in contact with a flame, spark or other heated material having a sufficiently high temperature—provided there is enough oxygen present for combustion—but no flame propagation and hence no explosion will occur.

Thus the *explosive range* is said to be between the concentration of combustible (flammable) gas existing at the lower limit and that existing at the upper limit, both expressed in percentage.

Table 1 gives the explosive range of the gases commonly encountered in the sewage works field.

## Hazardous Conditions

While noxious gases or vapors and oxygen deficiency may occur under a wide variety of conditions in sewers, the following locations are those of greatest danger:

1. All large trunk sewers, particularly those serving industrial areas.
2. Sewers located in the vicinity of gas mains or gasoline storage tanks. Streets paved with impervious coatings increase the hazard of gas leakage into sewers, since the gas cannot escape harmlessly at the surface, but seeks the path of least resistance and enters the nearest sewer.
3. Sewers on flat grades.
4. Sewers with manholes spaced more than 300 feet apart, especially if solid manhole covers are used and if main house traps are employed, the latter further preventing natural venting through house stacks.
5. All sewers more than 8 to 10 feet in depth below ground surface.
6. Any tightly covered pit, tank or valve chamber regardless of depth built as an adjunct of the sewer system.

## Hazardous Characteristics

Table 1 summarizes the characteristics of the common noxious gases and vapors encountered in sewer work, gives the likely sources of such

* The word "flammable" is preferable today to "inflammable."

Table 1
COMMON DANGEROUS GASES ENCOUNTERED IN SEWERS

| 1 | 2 | 3 | 4 | | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Name of Gas | Chemical Formulae | Specific Gravity or Vapor Density* (Air = 1) | Explosive Range (% by volume in air) Lower Limit | Upper Limit | Common Properties (Percentages below are percent in air by volume) | Physiological Effects (Percentages below are percent in air by volume) | Most Common Sources in Sewers | Simplest and Cheapest Safe Method of Testing + |
| Oxygen (In air) | $O_2$ | 1.11 | Not flammable | | Colorless, odorless, tasteless, non-poisonous gas. Supports combustion. | Normal air contains 20.93% of $O_2$. Man tolerates down to 12%. Below 5 to 7% likely to be fatal. | Oxygen depletion from poor ventilation and absorption or chemical consumption of available $O_2$. | Oxygen deficiency indicator |
| Gasoline | $C_5H_{12}$ to $C_9H_{20}$ | 3.0 to 4.0 | 1.3 | 7.0 | Colorless, odor noticeable in 0.03%. Flammable. Explosive. | Anesthetic effects when inhaled. 2.43% rapidly fatal. 1.1 to 2.2% dangerous for even short exposure. | Leaking storage tanks, discharges from garages, and commercial or home dry-cleaning operations. | 1. Combustible gas indicator<br>2. Oxygen deficiency indicator for concentrations over 0.3%. |
| Carbon Monoxide | CO | 0.97 | 12.5 | 74.2 | Colorless, odorless, tasteless, non-irritating. Flammable. Explosive. | Hemoglobin of blood has strong affinity for gas, causing oxygen starvation. 0.2 to 0.25% causes unconsciousness in 30 mins. | Manufactured fuel gas. | CO ampoules. |
| Hydrogen | $H_2$ | 0.07 | 4.0 | 74.2 | Colorless, odorless, tasteless, non-poisonous, flammable. Explosive. Propagates flame rapidly; very dangerous. | Acts mechanically to deprive tissues of oxygen. Does not support life. A simple asphyxiant. | Manufactured fuel gas. | Combustible gas indicator. |
| Methane | $CH_4$ | 0.55 | 5.0 | 15.0 | Colorless, tasteless, odorless, non-poisonous. Flammable. Explosive. | See hydrogen. | Natural gas, marsh gas, mfg. fuel gas, sewer gas** | 1. Combustible gas indicator<br>2. Oxygen deficiency indicator. |
| Hydrogen Sulphide | $H_2S$ | 1.19 | 4.3 | 46.0 | Rotten egg odor in small concentrations but sense of smell rapidly impaired. Odor not evident at high concentrations. Colorless. Flammable. Explosive. Poisonous. | Death in few minutes at 0.2%. Paralyzes respiratory center. | Petroleum, fumes from blasting, sewer gas.** | 1. $H_2S$ ampoules<br>2. 5% by wt. lead acetate solution. |
| Carbon Dioxide | $CO_2$ | 1.53 | Not flammable | | Colorless, odorless, non-flammable. Not generally present in dangerous amounts unless there is already a deficiency of oxygen. | 10% cannot be endured for more than a few minutes. Acts on nerves of respiration. | Issues from carbonaceous strata. Sewer gas.** | Oxygen deficiency indicator. |
| Nitrogen | $N_2$ | 0.97 | Not flammable | | Colorless, tasteless, odorless. Non-flammable. Non-poisonous. Principal constituent of air (about 79%). | See hydrogen. | Issues from some rock strata. Sewer gas.** | Oxygen deficiency indicator. |
| Ethane | $C_2H_6$ | 1.05 | 3.1 | 15.0 | Colorless, tasteless, odorless, non-poisonous. Flammable. Explosive. | See hydrogen. | Natural gas. | Combustible gas indicator. |

* Gases with a specific gravity less than 1.0 are lighter than air; those more than 1.0 heavier than air.
\+ The first method given is the preferable testing procedure. See section on gas testing for details.
** See definition in text.

gases and vapors, and lists the means for testing.

The conditions relating to oxygen deficiency are also summarized. The following remarks supplement the table. Tests for these gases and for oxygen deficiency will be discussed in detail in a following section.

### Oxygen Deficiency

It is emphasized that, aside from occasional explosions in sewers with resulting loss of life or property, oxygen deficiency appears to be the leading cause of death in sewers. Accident experience in recent years certainly support this statement. If carbon dioxide or nitrogen is present in sewers in hazardous amounts, then a deficiency of oxygen will invariably exist. Thus a test for oxygen deficiency is also a test for these latter gases.

### Manufactured Fuel Gas

If manufactured fuel gas has leaked into sewers its presence will be amply detected by tests for carbon monoxide and hydrogen, both of which are major constituents of manufactured gas. Manufactured fuel gas will be concentrated at the tops of manholes and explosions generally are localized to one or a few manholes.

### Methane

Tests for methane and ethane in sewers are increasingly important because of the widening use of natural gas by industries and homes. In such cases, natural gas is replacing manufactured gas in whole or part. Methane will be found principally at the tops of manholes, but the concentration will increase to a certain depth, where it remains constant. Explosions of methane and air generally are localized. Ethane, being slightly heavier than air, is likely to be concentrated near the bottoms of sewers. Since natural gas may contain both methane and ethane, tests for natural gas should preferably be made throughout the entire depth of the sewer manhole.

### Gasoline

Increasing urbanization is resulting in the building of more numerous gasoline filling stations, each of which creates a hazard from leaking underground gasoline storage tanks and gasoline spillage. Explosions in sewers from gasoline often are widespread and destructive. Because of its vapor density, the greatest concentration of gasoline or of petroleum vapors will be found in the lower portion of manholes.

### Hydrogen Sulphide

Hydrogen sulphide is an insidious gas and one to be thoroughly respected. Hydrogen sulphide test ampoules are a quick, easy, and dependable means for its detection. They should be used always where gas presence and oxygen deficiency are indicated by tests. The author ventures the opinion, however, that the danger from this gas in sewers has been overemphasized and that many of the deaths attributed to it have actually been caused by nothing more than a deficiency of oxygen in the atmosphere of the manhole.

### Industrial Vapors

There are other gases and vapors, which may be present in sewers, that are not listed in the table. These are largely industrial gases such as ammonia, sulphur dioxide, chlorine, carbon bisulphide, carbon tetrachloride and the like. The sense of smell is dependable for many of these and any evidence of foreign odor or irritation to the eyes should be heeded. Always take steps to thoroughly ventilate the sewer before entering. A few industrial gases and vapors, which might conceivably enter sewers, require special tests for their detection, but their presence is not a continuous, usual or serious problem. The local situation must dictate the precautions that should be taken in such cases.

The next installment will discuss the detection of noxious gases or vapors and oxygen deficiency.


*Announcing*

## The Scranton Publishing Company

Appreciative of the potentialities which this magazine possesses, I have purchased "WATER & SEWAGE WORKS" outright from the family firm which I served, as Executive Vice-president and Manager, for better than a quarter century.

Having severed my connection with the Gillette Publishing Co., I will now be able to devote my full time and efforts to the publication of "WATER & SEWAGE WORKS," and to the ever increasing needs of the rapidly expanding water, sewage and industrial waste fields.

* * *

Using my middle name, to avoid possible confusion, "WATER & SEWAGE WORKS" will henceforth be published under the name of the *Scranton Publishing Co.*, with headquarters in Chicago, at 185 North Wabash Ave.

With Linn H. Enslow as Editor, Harry A. Faber as Associate Editor, Fred C. Maurer as Assistant Editor, I can announce with great satisfaction that the editorial staff of "WATER & SEWAGE WORKS" continues the same, with the Editorial Office remaining in New York City at 155 East 44th Street. For the most part the business and sales staff will also be the same.

* * *

It is contemplated that "WATER & SEWAGE WORKS" will continue to provide its readers and advertisers the same high calibre of effective service that it has always provided in the past, as evidenced by a continuing increase in circulation and advertising volume during two decades of achievement and growth under the editorial guidance of Enslow, assisted by his able staff.

E. Scranton Gillette
*Publisher*

# BARMINUTOR*

## A New Comminution Development

CHICAGO SEWAGE EQUIPMENT

*Barminutor installed in 5' channel.*

**The Barminutor Model "A" exclusively provides the advantages of comminution with maximum economy for flows from 10 to 15 M.G.D. Screening and cutting of coarse sewage material is accomplished without removal from the flow, maintaining continuous cleaning of the screen. The Barminutor, developed and tested over five years, based on fifteen years successful experience with the Comminutor, eliminates odors and handling nuisance in the screening process. High rate cutting in the flow—comminution—provides low maintenance cost and long life for cutting parts.**

**In tests conducted on a Barminutor installed at the Indianapolis, Indiana Sewage Treatment Plant, the unit was subjected to test loads of screenings up to six times normal load for 40 M.G.D. This material was comminuted and the screen completely cleaned in six minutes. Even with this heavy load head loss through the screen did not exceed 6". Like the Comminutor, power requirements are low.**

### FUNCTION OF THE BARMINUTOR

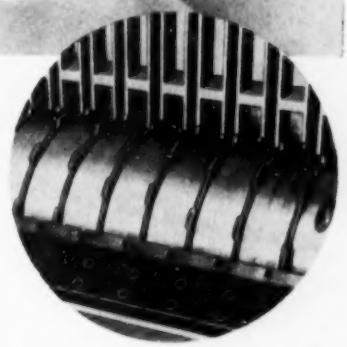
**1.** Cleaning the ¾" vertical bar screen and cutting of the screenings is accomplished by continual travel of the comminuting unit at 8 ft. per minute. Both upward and downward travel is controlled by an electric reversing brake motor.

**2.** The cutters on the comminuting unit, rotating at 400 R.P.M., travel within slots of the U-shaped bars and carry coarse material to the combs for cutting.

**3.** The direction of rotation automatically reverses when the direction of travel changes. The combs automatically position themselves to accomplish rapid cutting for each direction of rotation.

**4.** Uncuttable material is automatically rejected without damage to the cutting parts.

**5.** Rotation of cutters, position of combs and rejection of uncuttable material is accomplished through oil powered hydraulic system.



*Close-up of Cutters and Combs. Cutters rotate within slots of Bar and Comb.*

**Chicago Pump Company's trade name for its new screening and comminuting device for large sewage flows from 10 M.G.D.*

# CHICAGO PUMP COMPANY

## SEWAGE EQUIPMENT DIVISION

**622 DIVERSEY PARKWAY** — **CHICAGO 14, ILLINOIS**

Flush Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

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*. . . and a Budget Problem, too!*

**1. Costs Far Less to Install!**
A Ranney Water Collector will add millions of gallons to your daily water supply—at a fraction of the cost of conventional systems!

**2. Less Expensive to Operate!**
A Ranney Water Collector is far less expensive to operate—uses fewer pumps, fewer personnel, less power, and usually requires no treatment facilities.

**3. Maintenance Requirements Practically Nil!**
A Ranney Water Collector requires little or no maintenance. The rate of flow through the Ranney Collector's apertures eliminates clogging and silting. No filter plant maintenance.

**4. More Water per Unit!**
A single Ranney Water Collector has produced more clear, cool water than ten conventional vertical wells.

**5. Far Longer Life Cuts Depreciation Costs!**
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**6. Ask These Satisfied Users**
Ranney Water Collectors are currently rendering excellent service to scores of large water users such as:

E. I. duPont deNemours and Co., Inc.
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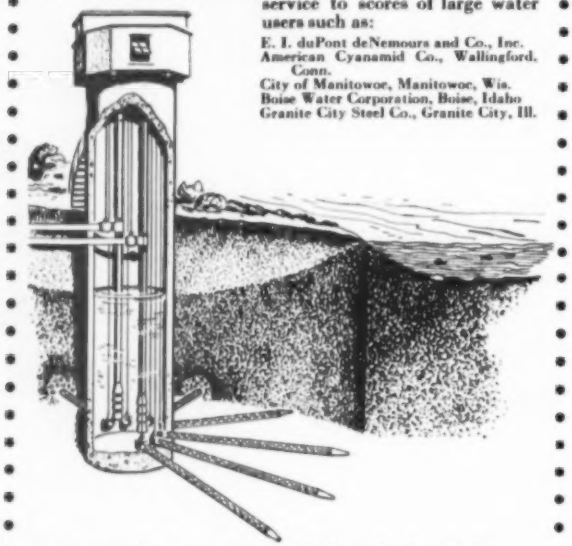
City of Manitowoc, Manitowoc, Wis.
Boise Water Corporation, Boise, Idaho
Granite City Steel Co., Granite City, Ill.



*An inexpensive Ranney survey will determine how the Ranney Method can work for you.*

If you need water, write us for complete information on how a Ranney Water Collector will solve your problem.

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HYDROLOGISTS AND WATER SUPPLY CONTRACTORS

Executive and Engineering Offices
Dept. C-6, P.O. Box 277, Columbus 9, Ohio


## Meetings Scheduled

Aug. 12—Sanford, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 16-21—Blacksburg, Va. *(Virginia Polytechnic Institute)*
VIRGINIA WATERWORKS, SEWAGE & INDUSTRIAL WASTES SHORT SCHOOL. Sponsored by V.P.I. and Virginia State Health Dept. Write—Dr. L. G. Rich, V.P.I., Blacksburg, Va.

Aug. 24-26—State College Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSN. Sec'y, R. R. Kountz, Penna. State College, State College, Pa.

Aug. 26-28—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSN. Sec'y, B. S. Bush, Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 1-5, Winnipeg, Can. *(Royal Alexandria)*
MINNESOTA SECTION A.W.W.A. Sec'y, L. N. Thompson, Water Department, St. Paul 2, Minn.

Sept. 2-4—Ames, Ia. *(Iowa State College)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, Leo Holtkamp, P.O. Box 310, Webster, Ia.

Sept. 2-3—Morgantown, W.Va. *(Hotel Morgan)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, G. O. Fortney, State Dept. of Health, Charleston, W.Va.

Sept. 3-4—Morgantown, W.Va. *(Hotel Morgan)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, H. K. Gidley, State Dept. of Health, Charleston 5, W.Va.

Sept. 3-4—Escanaba, Mich. *(Hotel Delta)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, State Dept. of Health, Lansing, Mich.

Sept. 9-11—Lake Placid, N.Y. *(Lake Placid Club)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 50 West 50 St. New York, N.Y.

Sept. 10-11—Cleveland, O. *(Hotel Cleveland)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

Sept. 21-23—Owensboro, Ky. *(Owensboro Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, R. Paul Farrell, 420 Sixth Ave., N., Nashville 3, Tenn.

Sept. 21-23—Owensboro, Ky: *(Owensboro Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y J. W. Finney, 420 6th Ave. N., Nashville, Tenn.

Sept. 21—Santa Fe, N.M. *(Hotel La Fonda)*
ROCKY MOUNTAIN SEWAGE WORKS ASSOCIATION. Sec'y, C. E. Harness, 271 City & County Bldg., Denver, Colo.

Sept. 22-23—Santa Fe, N.M. *(Hotel La Fonda)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, George J. Turre, Board of Water Commissioners, P.O. Box 600, Denver, Colo.

Sept. 21-23—East Lansing, Mich. *(Michigan State College-Kellogg Center)*
MICHIGAN SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, D. M. Pierce, Room 334 Administration Bldg., Lansing, Mich.

Sept. 21-22—Amherst, Nova Scotia *(Fort Cumberland Hotel)*
MARITIME BRANCH, CANADIAN SECTION A.W.W.A. Sec'y, J. D. Kline, P.O. Box 574, Halifax, N.S.

Sept. 22-24—Milwaukee, Wis. *(Hotel Pfister)*
WISCONSIN SECTION A.W.W.A. Sec'y, L. A. Smith, City Hall, Madison 3, Wis.

*(Continued on page 76A)*

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**CARLON** plastic pipe is ideal for municipal water systems . . . for sewage, drainage or any medium pressure, low temperature application because it's immune to rot, rust and electrolytic corrosion. **CARLON** assures long, leakproof service despite exposure to corrosive soils and waters. Periodic replacement is virtually eliminated.

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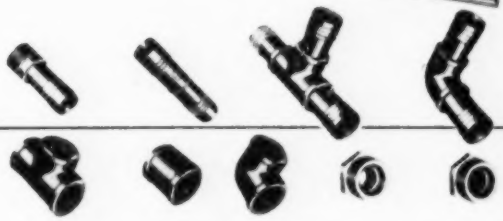

**The first real pipe that is plastic!*

*Buy the Pipe with the Stripe!*

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Aurora Non-Clog Pumps are available in both vertical and horizontal types—and are widely used in industry for handling liquid products, particularly heavy liquids and liquids containing solids. Also used for industrial by-products, semi-solids, wastes, municipal sewage etc. For impressive specifications and design features ask for BULLETIN 121-C.

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Sept. 22-24—Rapid City, S.D. *(Alex Johnson Hotel)*
SOUTH DAKOTA WATER & SEWAGE WORKS CONFERENCE. Sec'y. Charles E. Carl, State Dept. of Health, Pierre, S.D.

Sept. 23-25—Edmonton, Alberta *(Macdonald Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. (Operators' School Sept. 23) Sec'y, W. J. Waddell, 617-7th Ave. East. Calgary, Alberta.

Sept. 23-25—Omaha, Neb. *(Hotel Paxton)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, University of Nebraska, Lincoln, Neb.

Sept. 27-29—Excelsior Springs, Mo. *(Elms Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, Warren A. Kramer, State Office Building, Jefferson City, Mo.

Sept. 27-29—Excelsior Springs, Mo. *(Elms Hotel)*
MISSOURI WATER & SEWAGE CONFERENCE. Sec'y, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Sept. 28-30—Poland Spring, Me. *(Poland Spr. House)*
NEW ENGLAND WATER WORKS ASSOCIATION (72nd Annual Convention). Sec'y, Jos. C. Knox, 73 Tremont St., Boston, Mass.

Oct. 4-6—Jackson, Miss *(Hotel Heidelberg)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Chas. W. White, State Dept. Health, 537 Dexter, Ave., Montgomery, Ala.

Oct. 11-13—Miami, Fla. *(Hotel McAllister)*
FLORIDA SECTION A.W.W.A. Sec'y, William W. Aultman, Dept. of Water & Power, Box 316, Coconut Grove Sta., Miami 33, Fla.

Oct. 13-16—Miami, Fla. *(Municipal Auditorium)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSN. (26th Annual Meeting). Exec. Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(joint meeting with)
FLORIDA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, D. P. Schiesswohl, P.O. Box 210, Jacksonville, Fla.

Oct. 14—Rumsford, Me.
MAINE WATER UTILITIES ASSOCIATION (Annual Meeting). Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 14-16—Waterloo, Iowa *(Hotel Russell Lamson)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pederson, Municipal Bldg., Marshalltown, Iowa.

Oct. 18-21—Houston, Tex. *(Rice Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, L. A. Jackson, Robinson Auditorium, Little Rock, Ark.

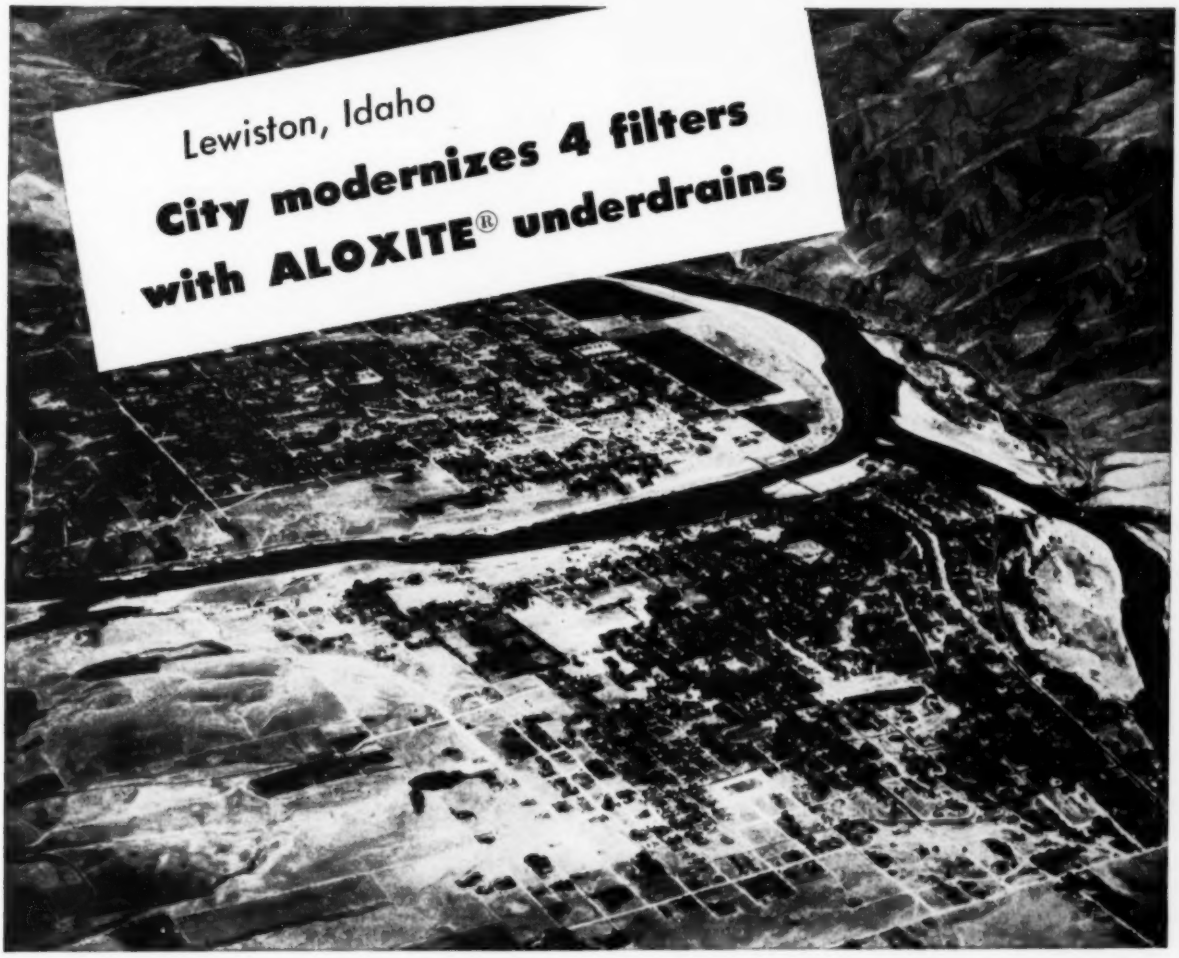
Oct. 19-24—New York, N.Y. *(Eng. Societies Bldg.)*
AMERICAN SOCIETY OF CIVIL ENGINEERS (Annual Meeting). Sec'y, Wm. N. Carey, 33 W. 29 Street, New York 18, N.Y.

Oct. 20-23—Atlantic City, N.J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, W. A. Kufs, 510 Telegraph Bldg., Harrisburg, Pa.

Oct. 22-24—Atlantic City, N.J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.

Oct. 26-28—Niagara Falls, Ont. *(General Brock Hotel)*
CANADIAN INSTITUTE ON SEWAGE & SANITATION. Sec'y, Dr. A. E. Berry, Parliament Bldgs., Toronto, Ont.

(*Continued on page* 78A)




Information courtesy Lewiston Water Dept., Lewiston, Idaho. Photo shows Lewiston in the foreground and Clarkston, Washington in the background across the Interstate Bridge.

Lewiston, Idaho has four filters. Installed in 1924, these were originally of the conventional type with pipe lateral underdrains and graded gravel. First in 1934, and again in 1950 they required rebuilding. The beds were badly upset, the laterals clogged and corroded.

The last time the filters needed rebuilding, the Engineering Dept. decided to see if there were other, more stable types of underdrains. After investigating all systems, ALOXITE aluminum oxide porous plates were singled out as probably the best. One reason was that they seemed less difficult and less expensive to adapt to the old filter construction.

Letters were then sent to operators using these plates, inquiring as to their success in service. Many favorable replies were received, one all the way from Nykoping, Sweden—and, as a result, all four filters were modernized with ALOXITE porous-plate bottoms.

To quote from Lewiston's 1951 City Engineer's Annual Report: "(The new filters) have given the utmost satisfaction. They wash evenly and the initial loss of head is less than it was with the original construction."

***Our congratulations to Lewiston on a thorough job of investigation, and a careful job of installation. We know the City will continue to be pleased with the low operating and maintenance costs of these porous-plate underdrains.***

**THE FULL LEWISTON STORY** is described in a magazine article by W. H. Berkeley reprinted from the AWWA Journal. It tells of their experiences with graded gravel, pipe lateral bottoms, describes how they installed the porous plates, and outlines the benefits derived from the new underdrains. A copy of this article, together with a 56-page booklet on porous media, will be sent free of charge. Simply address: Dept. M-83, Refractories Div., The Carborundum Company, Perth Amboy, N. J. Both are very worth-while.

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Oct. 26-29—New Orleans, La. *(Roosevelt Hotel)*
AMERICAN PUBLIC WORKS ASSOCIATION. Exec. Sec'y, Donald F. Herrick, 1313 East 60th St., Chicago, Ill.

Oct. 27-28—Springfield, Ill.
ILLINOIS WATER PLANT OPERATORS. (22nd Annual Fall Convention). Sec'y, Charles L. Baylor, Downers Grove, Ill.

Oct. 27-30—Philadelphia, Pa. *(Benjamin Franklin Hotel)*
NATIONAL WATER WELL ASSOCIATION. Sec'y, Robert R. Storm, 811 W. Springfield, Champaign, Ill.

Oct. 27-30—San Francisco, Calif. *(Palace Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, J. C. Luthin, 1113 Laurent St., Santa Cruz, Calif.

Oct. 28-30—Wilmington, Del. *(Hotel DuPont)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, C. J. Lauter, 6955 33rd Street, Washington 15, D.C.

Nov. 4-6—Roanoke, Va. *(Hotel Roanoke)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanagh, 915 Colonial-American Bank Bldg., Roanoke, Va.

Nov. 5—East Providence, R.I. *(Wannamoisett Country Club)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R.I.

Nov. 5-7—Yakima, Wash. *(Hotel Chinook)*
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTE ASSOCIATION. Sec'y, Robert O. Sylvester, Univ. of Washington, Seattle, Wash.

Nov. 9-11—High Point, N.C. *(Sheraton Hotel)*
NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N.C.

Nov. 9-11—High Point, N.C. *(Sheraton Hotel)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N.C.

Nov. 12-13—Lincoln, Neb. *(Hotel Capitol)*
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Paul W. Mousel, 602 W. B. Street, McCook, Neb.

Nov. 18-23—New York, N.Y. *(Statler & New Yorker)*
AMERICAN PUBLIC HEALTH ASSOCIATION. Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N.Y.

Nov. 16-20—Stillwater, Okla. *(Okla. A. & M. College)*
OKLAHOMA WATER, SEWAGE & IND. WASTES SHORT COURSE. Sec'y, H. J. Darcey, State Dept. of Health, Oklahoma City, Okla.

Dec. 9—Waterville, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Dec. 13-16—St. Louis, Mo.
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. (Annual Meeting). Sec'y, F. G. Van Antwerpen, 120 East 41st St., New York 17, N.Y.

Jan. 19, 1954—New York, N.Y. *(Hotel Commodore)*
NEW YORK SECTION A.W.W.A. (Winter Luncheon Meeting). Sec'y Kimball Blanchard, 50 West 50th Street, New York, N.Y.

Jan. 21-22—New York, N.Y. *(Hotel New Yorker)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Ralph C. Sweeney, 21 No. Broadway, White Plains, N.Y.

Apr. 22-23—Watertown, N.Y. *(Woodruff Hotel)*
NEW YORK SECTION A.W.W.A. Annual Spring Meeting. (Registration evening of 21st). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.


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Modern in design and operating principle, the Hellige Turbidimeter does not require standard suspensions or long cumbersome tubes. Accurate readings can be made rapidly by those without technical training.

Precise determinations are performed in the ranges of zero to 150 p.p.m. $SiO_2$ and zero to 100 p.p.m. $SO_4$. Higher values are determined by diluting the specimen.

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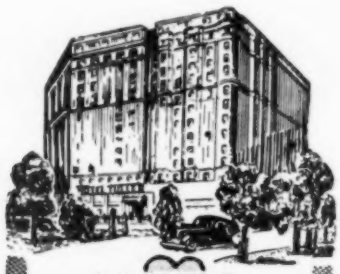

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First thing to do in Detroit is check in at Hotel Tuller! You'll enjoy every minute. Newly modernized. Beautifully decorated. Within walking distance of all downtown stores, theatres and business activities . . . yet, you enjoy the evergreen atmosphere of Grand Circus Park . . . The Tuller Coffee Shop or Cafeteria for excellent food modestly priced.

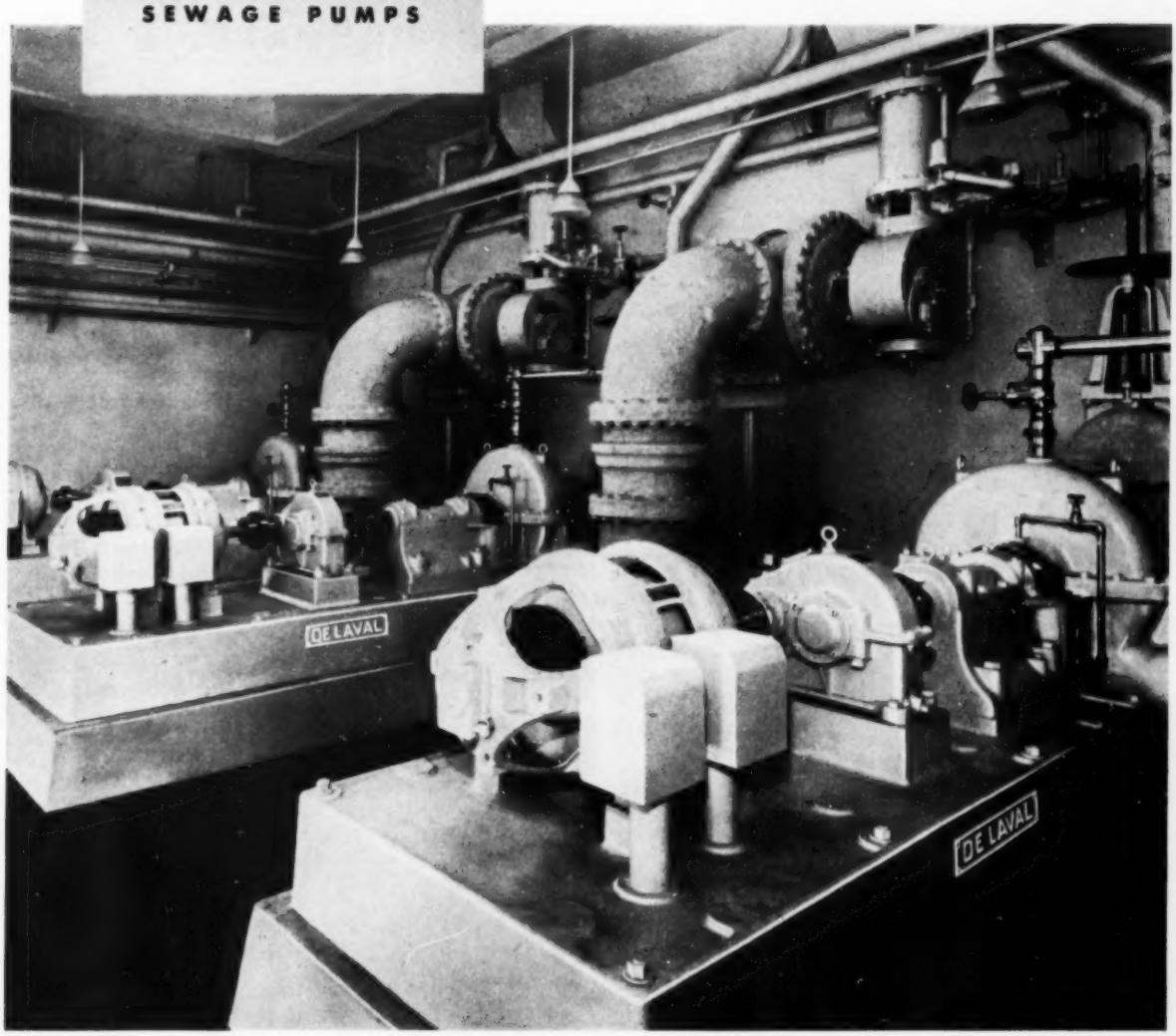
VISIT OUR COCKTAIL LOUNGE
ONE OF DETROIT'S FINEST

800 ROOMS from $3

Harry E. Paulsen, *Gen. Mgr.*

HOTEL TULLER

# DE LAVAL SEWAGE PUMPS *serve Baltimore's new plant*




Three De Laval sewage pumps are on the job in the City of Baltimore's new Brooklyn Sewage Pumping Station built for today's need and planned for future expansion.

Two of these high efficiency motor-driven horizontal pumps have a capacity of 3,000 gpm and the third has a capacity of 7,000 gpm. Later, as flow increases, the two 3,000 gpm units can be replaced by a 7,000 gpm pump.

Slow speeds of these De Laval pumps insure long life, large passageways reduce clogging and nickel-chrome cast iron casings and impellers assure long wear.

Baltimore is another of a long list of cities being served by De Laval pumps. A complete centrifugal pump line is built on 50 years experience at De Laval—pioneer in the municipal pumping field.

**DE LAVAL** *Sewage Pumps*

DE LAVAL STEAM TURBINE COMPANY
*824 Nottingham Way, Trenton 2, New Jersey*

## New England Convention Exhibitors

The following members of the Water and Sewage Works Mfgrs. Assn., have reserved exhibit space for the convention of the New England Water Works Assn., to be held at the Poland Spring House, Poland Spring, Maine, September 28-30, 1953.

American City Magazine
Badger Meter Mfg. Co.
Builders-Providence, Inc.
Centriline Corp.
Chicago Bridge & Iron Co.
Dresser Mfg. Div.
Hersey Manufacturing Co.
Hydraulic Development Corp.
Johns-Manville
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BUILDERS Visible Flow CHLORINIZER combines the two vital design elements that insure complete chlorine control: (1) a chlorine flow regulating system that's easy-to-operate and positive-acting and (2) an easy-to-read, linear scale, visible-flow indicator. You adjust the handy chlorine control valve until the *Sightflo Indicator* shows the exact chlorine feed you need. The Sightflo indicator meters the actual chlorine flow — gives you accurate flow facts that help you keep chlorination operations under complete control at all times.

Get full details on BUILDERS Visible Flow CHLORINIZERS — the *modern* chlorine gas feeders. Write to Builders-Providence, Inc. (Division of B-I-F Industries), 350 Harris Ave., Providence 1, R. I.

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## New England Interstate Pollution Control Comm. Elects New Officers

At the recent annual meeting of the New England Interstate Water Pollution Control Comm., Harry Manson, chairman of the New Hampshire Water Pollution Commission was elected chairman of the Commission. The new Vice-Chairman of the Commission is Roger L. Putnam, Chairman of the Board, Package Machinery Company, Springfield, Mass. Joseph B. Hanlon, Supt. of Sewage Treatment Plants of the Boston Metropolitan District Commission was elected Treasurer.

Cooperative classification studies on interstate waters to be undertaken by the States during the coming year include: the Thames River in Massachusetts and Connecticut; tributaries of Lake Champlain in New York and Vermont; the Taunton River and Mt. Hope Bay in Massachusetts and Rhode Island; the Hoosic River and tributaries in Massachusetts, Vermont and New York, and Piscataqua Bay in New Hampshire and Maine.

The Commission will continue its program of surveys and research on industrial wastes to assist management in providing feasible and economical methods of waste treatment. This work will be carried on for the Commission during the coming year at the University of Rhode Island and at Wesleyan University in Connecticut. In this connection the Commission announces the release of a report dealing with an investigation of the polluting characteristics of wastes resulting from the finishing of cotton goods.

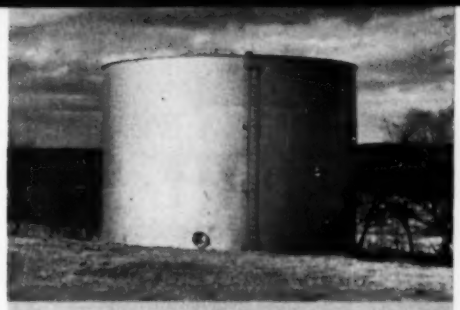
## A.S.C.E. Metropolitan Section Sanitary Engineers Have Local Organization

A Sanitary Engineering Group that grew out of a desire for technical division activity at the local level has been formed within the Metropolitan Section of the American Society of Civil Engineers. The group has a potential membership of some 350 members of ASCE in the area having sanitary engineering as their prime interest. It is also open for membership

# Steel RESERVOIRS and STANDPIPES

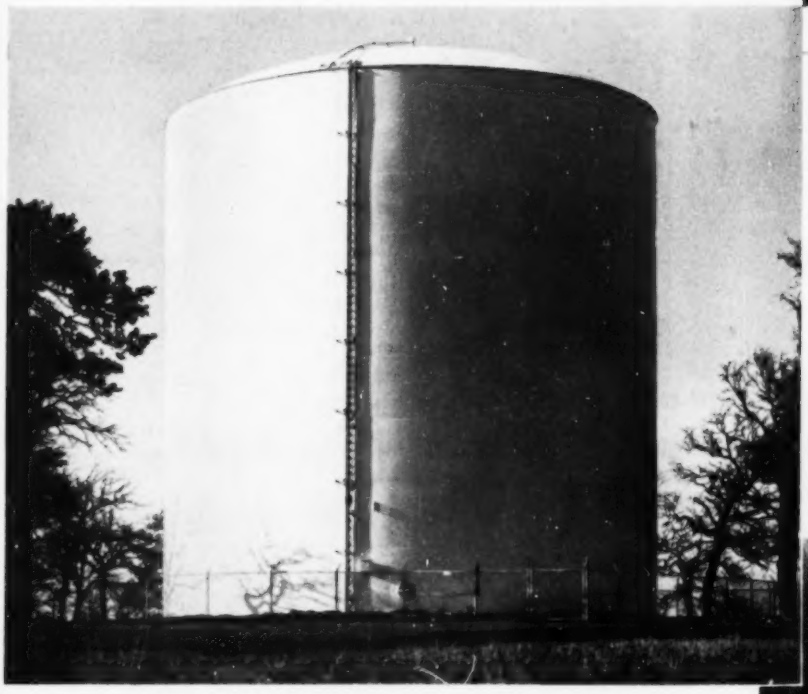
**for economy and dependability in community water storage**

## by PITTSBURGH • DES MOINES

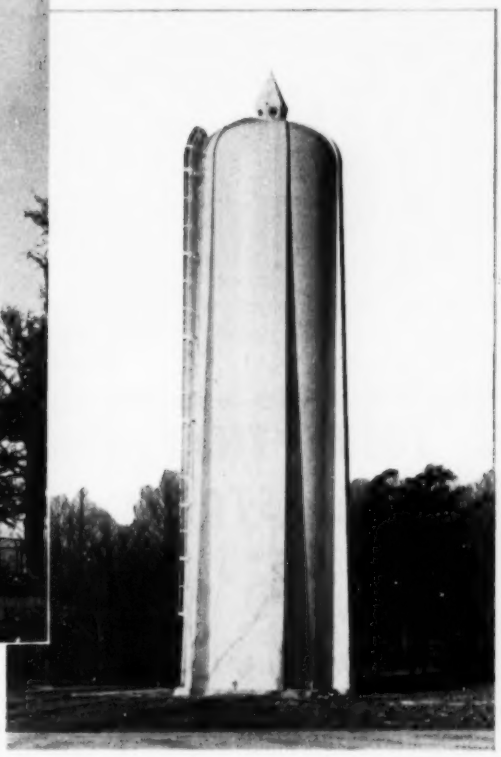


LIBERTY, N. Y.—300,000-gallon flat cone roof reservoir. 42 ft diameter, 29 ft 3 ins high

BUENA VISTA, VA.—300,000-gallon standpipe, ellipsoidal roof. 36 ft diameter, head range 42 ft



DENTON, TEXAS—2,000,000-gallon dome roof reservoir. 70 ft diameter, 70 ft 6 ins high



ARLINGTON, VA.—225,000-gallon standpipe, ornamental pilasters and vent. 22 ft diameter, head range 80 ft

Low in first cost, inexpensive to maintain, Pittsburgh-Des Moines Steel Reservoirs and Standpipes provide lifetime durability, uniform high strength, permanent watertightness—and are unaffected by frost or climatic change. Erection is practical the year around. Write for our descriptive Bulletin.

**PITTSBURGH • DES MOINES STEEL CO.**

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to persons outside ASCE, who will be considered for non-voting alliance as associates.

Prof. William Ingram of New York University is chairman, and William A. O'Leary of the New York City Department of Public Works is vice-chairman. Committee members include Torris Eide, Richard Hazen, Arthur Herberger and Robert M. Pope; Alex Diachishin is the group's secretary-treasurer.

John Baffa, as program committee chairman, is arranging for its first activity dinner for the entire Sanitary Engineering Division, as its major social event at the forthcoming October convention of the ASCE in New York.

# NEW WATER & SEWAGE REPORTS

**The Water Resources of Virginia.** Three new comprehensive bulletins issued by the Division of Water Resources, State Department of Conservation and Development. They contain stream flow data for the period October 1, 1942, to September 30, 1950, and have been prepared cooperatively by the U.S. Geological Survey.

Bulletin No. 13: "Surface Water Supply of Virginia, James River Basin, 1942-1950" (394 pages).

Bulletin No. 14: "Surface Water Supply of Virginia, Chowan and Roanoke River Basins, 1942-1950" (333 pages).

Bulletin No. 15: "Surface Water Supply of Virginia, New, Big Sandy and Tennessee River Basins, 1942-1950" (296 pages).

These bulletins are available upon request to the Division of Water Resources, Virginia Department of Conservation and Development, P.O. Box 1338, University Station, Charlottesville, Virginia.

* * *

**Water Pollution Research 1952.** This 64-page report summarizes the work of the British Water Pollution Research Board during the past year.

Water research items include: Some factors affecting the bactericidal action of chlorine; enumeration of *Streptococus faecalis* in polluted waters; removal of radio-iodine during the normal treatment of water.

Sewage research items: Biological and mechanical filtration methods, and Treatment of sewage containing spent gas liquor.

Industrial waste water research items include studies of treating those from cotton kiering, cyanide baths, and other investigations.

Polluting effects were studied with reference to the toxicity of substances to fish, and in a detailed survey of the Thames River estuary.

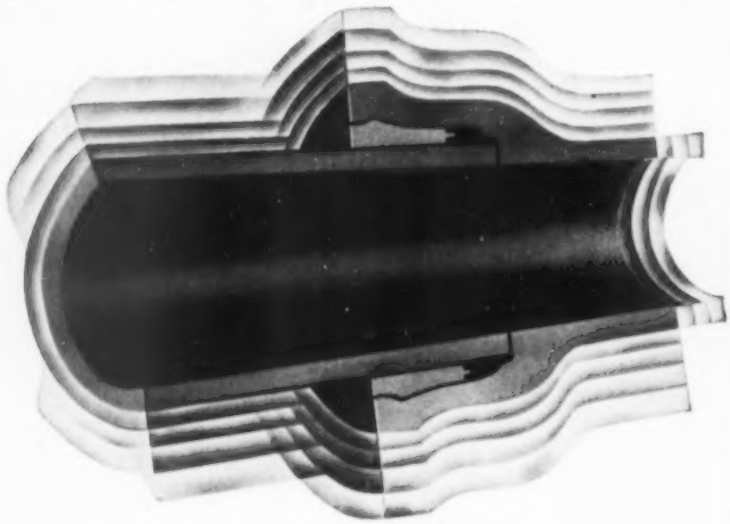
Copies of this report may be purchased in the U.S. ($.65) from: British Information Services, 30 Rockefeller Plaza, New York, 20, N.Y.

* * *

**Industrial Waste Surveys of Two New England Cotton Finishing Mills.** A study sponsored by the New England Interstate Water Pollution Control Commission as an aid to Textile industries in the compact area in solving waste disposal problems. The textile industry accounts for 47 per cent of the total industrial pollution load.

Two surveys are included and report detailed studies of cotton finishing wastes made by Wesleyan University and the University of Rhode Island. Copies of this 82-page report may be obtained from the Commission, 73 Tremont Street, Boston 8, Mass.

(Continued on page 84A)



A JOINT THAT KEEPS ITS HEAD
...under STRESS and VIBRATION

Long after you backfill the trench, water pipe joints poured with ATLAS MINERALEAD® provide leak-free performance without maintenance . . . protected by a bond permanently able to withstand stress, vibration and deflection.

This plasticized, sulfur base compound flows freely . . . handles easily . . . seals to a leakproof bond without caulking. In addition, ATLAS MINERALEAD melts without bubbling or frothing or settling out in the melting pot. Both time and material are saved at every step of the jointing procedure . . . as proven by over a quarter of a century of usage.

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ATLAS JOINTING COMPOUNDS
... a permanent bond

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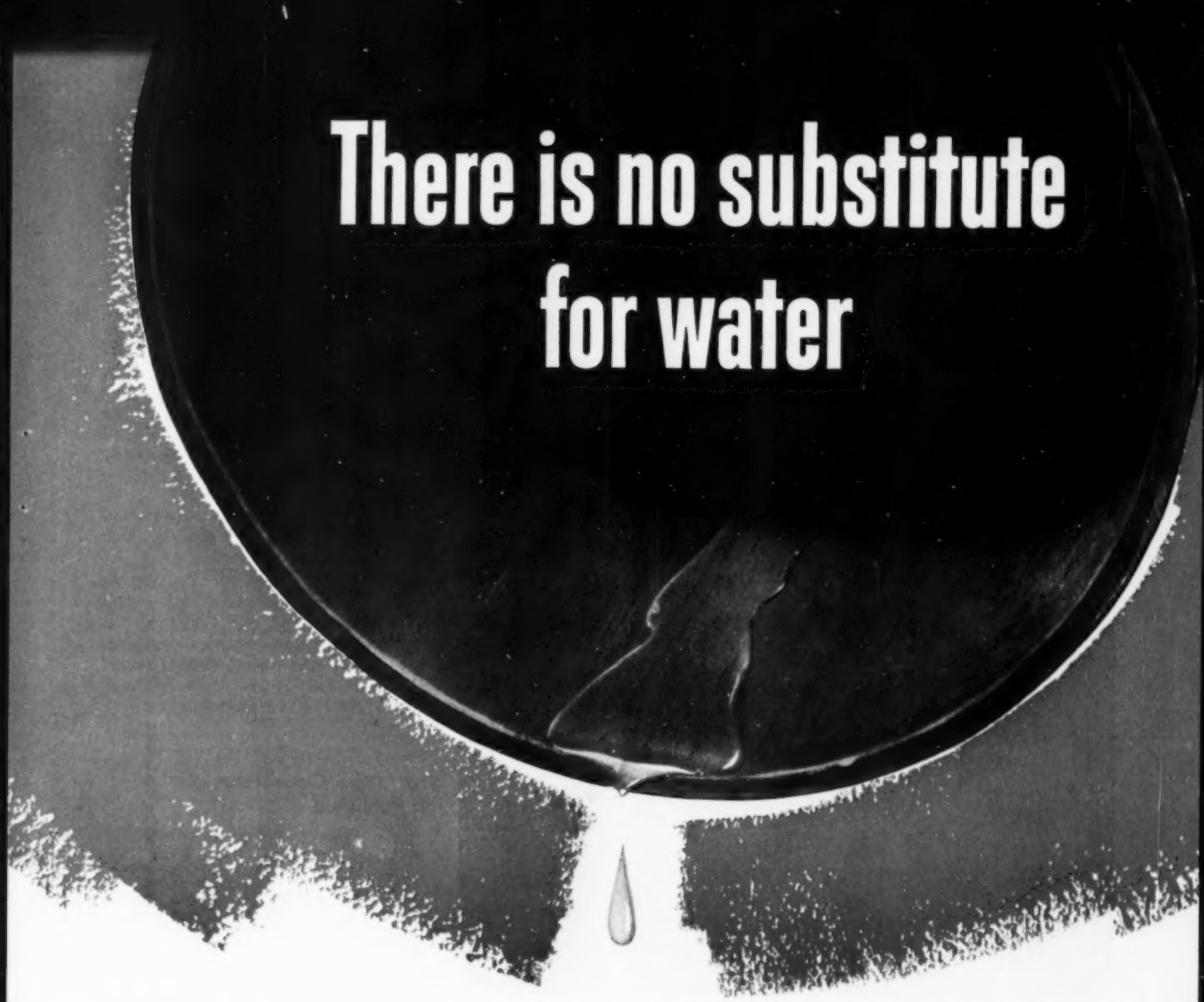
MERTZTOWN, PENNSYLVANIA

Engineering Representatives throughout the United States

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Nothing has ever taken the place of water among the basic needs of man. And nothing will ever take the place of safe, sure, *experienced* engineering in developing a dependable water supply.

Layne's reputation as the world's most experienced developer of well water systems was earned by engineering skill every step of the way—from on-the-spot geological surveys to the precision designing of each pump for its particular job. For the best in well water systems, there is no substitute for Layne engineering.

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Layne welcomes the opportunity to share in long-range planning for water-system needs. Contact your nearest Layne Associate Company or write Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

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**WATER WELLS**

**VERTICAL TURBINE PUMPS**

*Layne Associate Companies Throughout the World*

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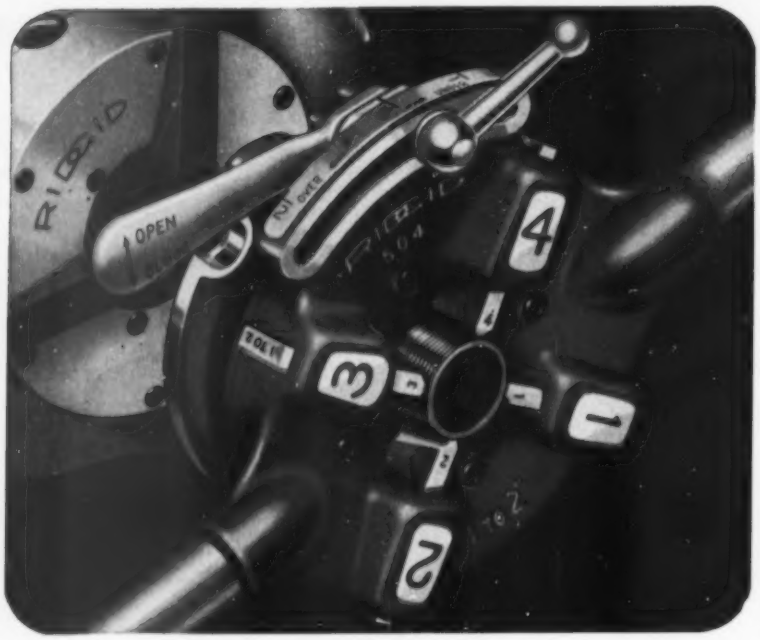
## Quick-Opening
# "504" PIPE THREADER
## for Power Drive use




## Threads 1" to 2" pipe with 1 set of dies

You can't beat this new "504" for fast smooth threading with power drive! Changes instantly from size to size regardless of position of quick-opening lever . . . Release ball handle, move indicator line to 1", 1¼", 1½" or 2" on size bar, tighten—it's ready to thread! Quick-opening handle retracts dies instantly without stopping power drive—no slow backing off. 4-jaw workholder centers pipe for accurate threading. No lead screw to jam. Easy-to-read size bar. Adjustable to over and under size threads. See it . . . try it . . . buy the new "504" at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID
Work-Saver Pipe Tools


**Radioactive Waste Removal in a Trickling Filter Plant.** This 12-page report describes the design (and studies on which it was based) of the first modified trickling filter plant to treat simultaneously domestic sewage and "hot" laundry wastes. (The laundry wastes result from washing contaminated protective clothing.)

The full scale plant is being installed at the National Reactor Testing Station of the AEC near Idaho Falls, Idaho. Reports will be made as to the effectiveness and cost of the treatment. It is hoped that the plant operation may indicate a relatively simple and cheap method for the disposal of radioactive wastes. It is probable that the digested sludge will contain so much radioactivity that special handling will be required.

Copies of the report, prepared by A. L. Biladeau, Sanitary Engr., may be obtained from the Technical Information Branch, Idaho Operations Office, U.S. Atomic Energy Comm., P.O. Box 1221, Idaho Falls, Idaho.

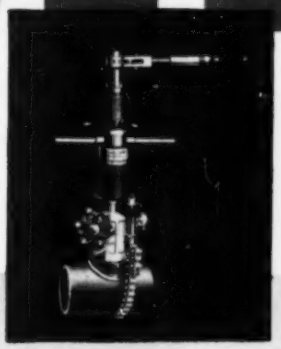
## Short Course Bulletin for W&S Operators Is Published

The Engineering Experiment Station of Louisiana State Univ., announces that Bulletin No. 36, "Proceedings of the Fifteenth Annual Short Course for Water and Sewage Plant Superintendents and Operators, 1952" is ready for distribution. There is a charge of fifty cents for this bulletin. Please do not send stamps. For copies address Paul C. Koons, Acting Director, Engineering Experiment Station, Louisiana State University, Baton Rouge 3, Louisiana.

"Yes I did: And, it's going to stay right there until you stop that smoking in bed!"

# MUELLER®

## FOR THE FINEST IN WATERWORKS EQUIPMENT

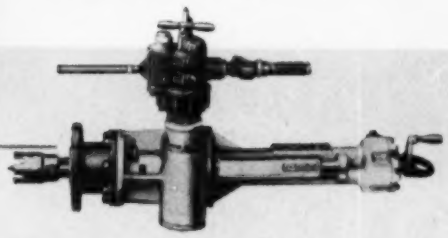


### "B" Tapping and Inserting Machine

Drills and taps mains and inserts corporation stops, ½" to 1", under pressure... may be used on dry taps, ⅜" to 2½"... similar machines available in larger sizes.

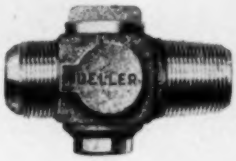
### "C-1" Drilling Machine

Makes cuts 2" to 12" in any size main... dry or under pressure... power-operated with H-600 Air Motor or H-602 Gasoline Engine Drive Unit... hand-operated model also available.



### Corporation Stops

Designed for insertion in mains under pressure with Mueller Tapping and Inserting Machines... wide range of sizes and types... variety of inlet threads ...fully tested.




### Curb Stops

Ground key stops... steeper taper on key prevents sticking and allows easy operation... inverted key or solid tee head type available... wide range of sizes ...fully tested.

### Service Clamps

Designed for cast iron, steel, asbestos cement, or wrought iron pipe... double or single strap... full length threads ...neoprene or lead ring gaskets ..wide range of sizes and tappings.

### Meter Setting Equipment

Copper or iron meter yokes... flat head or lock wing angle stops... meter couplings ..complete line available... variety of threads and outlets.

### Gate Valves

Exclusive four-point contact wedging mechanism assures positive seal... fully bronze mounted... maximum corrosion resistance... conventional packing or "O" Ring Seals... rising or non-rising stems A.W.W.A.

### Fire Hydrants

Improved and standard types... designed and built for long life and trouble-free service ..safety flange reduces collision damage... A.W.W.A.

▶ These products are just a portion of the complete selection of waterworks equipment, supplies and specialties offered by Mueller Co. and designed and manufactured to their characteristically high standards.

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## Pickups from Purdue's "Sanitary Engineering News"

Don E. Bloodgood, Editor

Sludge sales during 1952 totaled $750.00 for the city of Wassau, Wis. At Sheybogan, Wis., an average of 900 tons of sludge is sold annually, netting approximately $5,000.

* * *

Industrial managements seeking sites for new chemical-processing plants are now including stream investigations and surveys in the preliminary studies before locations are selected.

The late Chief Justice, Oliver Wendell Holmes once said, "A river is more than an amenity, it is a treasure. It offers a necessity of life that must be rationed among those who have power over it."

* * *

One of the 15-year-old gas engines at Oshkosh, Wis., has recently completed a continuous run of 8,218 hours.

* * *

Some of the largest corrugated metal sewer pipe ever manufactured has just been installed in Middletown, Ohio. This is 102 inch diameter Armco pipe.

## Welsbach Appoints Sales Agent

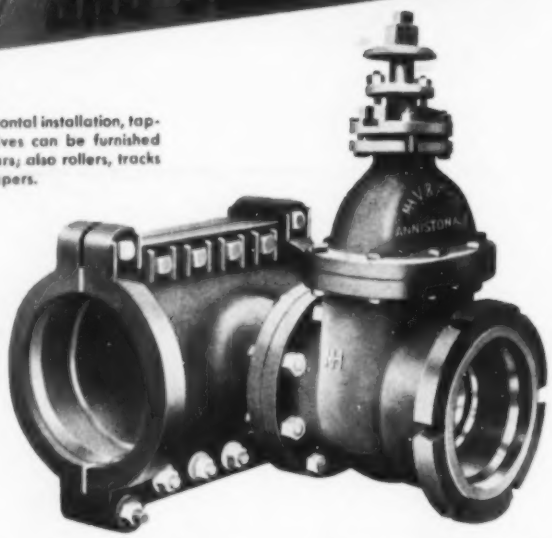
The Welsbach Corporation, Kitson Valve Division of Philadelphia, Pa., has announced the appointment of Jaffe Sales Company as their representative in the Chicago-Milwaukee areas. They will call on Plumbing, Heating and Industrial Wholesalers with the entire Welsbach-Kitson line of water stops, steam cocks, gas stops, balancing valves and fittings, relief valves, brass bath traps and plumbing specialties.

Mr. Adolph Jaffe is associated with his son, Jack A. Jaffe, in the Chicago office of the company at 7709 South Yates Avenue. Mr. Herbert Schroeder is manager of the Milwaukee office which is located at 312 East Wisconsin Avenue.

FOR TAPPING MAIN UNDER PRESSURE

M&H TAPPING VALVE and SLEEVE

For horizontal installation, tapping valves can be furnished with gears; also rollers, tracks and scrapers.

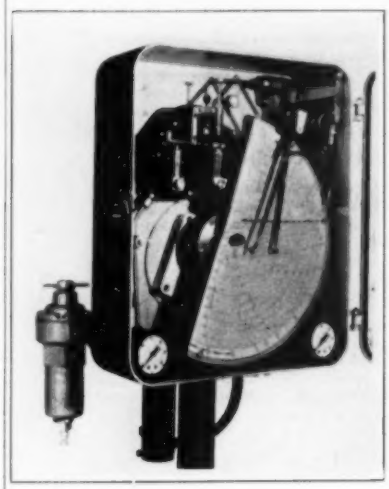


A. W. W. A.—CLASS C

Designed for tapping a main under pressure to take off a branch larger than corporation cock size. Flange on one side of valve bolts to sleeve; other side of valve may be hub or mechanical joint connection, either of which has special flange cast integral for attaching any standard make tapping machine. Can be furnished with rising stem for use in manhole or valve pit. Features of M & H sleeves are strong, heavy design and liberal length.

M & H Tapping Valve meets specification of A. W. W. A. Class C and Tapping Sleeve is Manufacturer's Standard. For complete information, write or wire M & H VALVE AND FITTINGS COMPANY, Anniston, Alabama.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION



## Differential Controller

801

Rockwell Manufacturing Company, Pittsburgh, Pa., has just developed a differential controller for change-over valves.

The new device has been designed for orifice meter measuring stations

# PORT WASHINGTON, WIS.

## Water Filtration Plant

(Completed in 1949)

GREELEY and HANSEN
*Consulting Engineers*
Chicago, Ill.

CHARLES A. HONOLD
PLUMBING CO.
*Contractors*
Sheboygan, Wis.

JOSEPH J. DUFFY
*General Contractor*
Chicago, Ill.

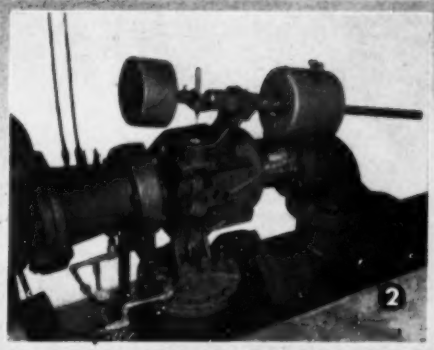
B-I-F Industries Equipment furnished for the Port Washington Filtration Plant:

**BUILDERS**

- Filter Operating Tables, and Gauges (1), Filter Controllers (2)
- Chronoflo Indicator-Recorder for remote standpipe water level
- Wheeler Filter Bottoms

**OMEGA**

- Loss-in-Weight Gravimetric Feeders for Carbon, Alum and Lime
- Gravimetric Fluoridizer




This modern filtration plant stands as a monument to civic pride and civic planning. The plant combines clean, attractive design with functional efficiency. Maintenance is top-notch — "you could eat off the floor". Treatment processes are readily adjustable to compensate for seasonal variations in raw water. The Port Washington Filtration Plant insures a safe, adequate supply of potable water for Port Washington's 12,000 population, and for its many industries. Plant management is under the direction of Alvin G. Bares, Superintendent.

Builders is proud to have contributed its part to this fine, up-to-date plant. Builders Instruments and Controls are serving in every phase of this plant's operation from the raw water intake through coagulation, sedimentation, filtration, and water storage. For Bulletins describing Builders Water Works Equipment, address Builders-Providence, Inc., (Division of B-I-F Industries), Providence 1, Rhode Island.

**BUILDERS**

B-I-F INDUSTRIES — PIONEERS IN METERS AND CONTROLS — BUILDERS

where a wide variation of flow conditions is encountered. It offers, the manufacturer claims, an easy, positive and economical means of automatically turning an additional measuring unit into the line when needed and shutting it off completely when not needed.

The object of the procedure is to obtain accurate measurement where there is considerable variation in flow.

The controller operates in the following manner:

When the differential across the primary orifice reaches a pre-determined maximum setting the controller actuates the four-way valve. This valve admits the supply from the regulator to the cylinder opening the Nordstrom valve. This puts the secondary meter into service in addition to the primary meter.

When the load drops and the differential of the two meters in operation falls below the pre-set minimum, the four-way valve is repositioned by the controller. This admits pressure to the cylinder. The pressure closes the Nordstrom valve and shuts off the secondary meter.

The differential control unit is mounted in the orifice meter case, offering a compact unit of rugged construction and assured accuracy. The orifice meter which actuates the differential control mechanism also serves as the primary measuring unit.

A cylinder-operated Nordstrom valve is used to give trouble-free, positive shutoff. As no additional motor valve is required, the amount of equipment is reduced and the size of installation and housing is small. Action of the valve is accomplished by a sturdy mechanism which is also provided with a low torque manual operation for optional use.

A minimum of 10 p.s.i. is required to actuate the control unit and 50 p.s.i. to operate the Nordstrom valve cylinder. This supply can be obtained from the line ahead of the Nordstrom valve. The same regulator which determines the supply to the control unit also reduces the line pressure to the point required to operate the Nordstrom valve cylinder.

TANK
with a FUTURE
This tank in some respects looks like hundreds of others, but unlike many, it has a brighter future of longer life and greater service, because it is protected by an Electro Rust-Proofing system.
Efficient control of corrosion on submerged surfaces requires much engineering, some equipment. Careful analysis of your problem . . . design, installation and testing by men who are experienced in their work . . . the "know-how" of an established firm . . . "follow through" of every job—on these and similar engineering details rest effective cathodic protection.
Highly trained, backed by a long list of successful installations and years of experience, our engineer is always ready to help you solve your corrosion problem. For complete information, write today.
ERP-21
ELECTRO RUST-PROOFING CORP. (N. J.)
BELLEVILLE, NEW JERSEY
Over 15 years of cathodic protection engineering, research and development
COMPLETE CATHODIC PROTECTION SERVICE
DESIGN
ENGINEERING
INSTALLATION
MAINTENANCE
EQUIPMENT

## Coffman Elected Vice-President of Omega Machine

Omega Machine Co., Providence, R.I., has announced the election of Mr. Paul R. Coffman as Vice-President.

Mr. Coffman came to the Omega Machine Co. in 1934, following a brief period in retail selling. He was, at one time, a member of a family group that invented a method of reclaiming oil and organized the Coffman Reclaiming Oil Co.

In addition to his new duties as Vice-President of the Omega Machine Co., Mr. Coffman continues as a director of the Company. He is a member of the American Water Works Association and has authored several papers.

He joined Omega as a mechanic and during almost nineteen years of continuous services became a Foreman, service Engineer, Shop Superintendent, Production Control Manager, Purchasing Agent, Service Manager, Manager of Industrial Sales and Chief Engineer. Mr. Coffman continues as Chief Engineer along with his new position as Vice-President.

# HERSEY

This

## HERSEY COMPOUND METER

has never been equaled for capacity and the accurate registration of all rates of flow

*Self-contained bronze case up to 6 inches*

**HERSEY MANUFACTURING COMPANY**

SOUTH BOSTON, MASS.

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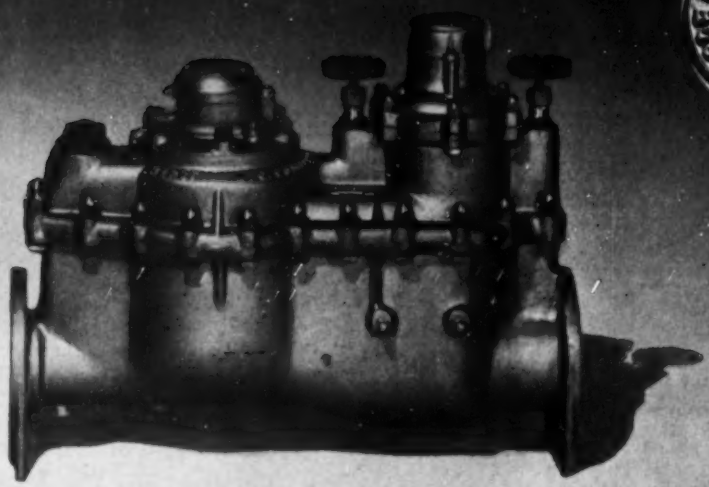

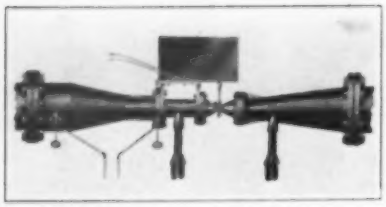

## Sludge Controller

802

Simplex Valve & Meter Co., Philadelphia, Pa., has developed a Sludge Controller of the electrical transmission mechanical type. Essentially, this 8-inch diameter squeeze controller is designed to control the flow of sludge or heavily laden liquids. The device is said to overcome most of the difficulties of regulating heavy viscous flows, even if corrosive, without affecting the moving parts of the controlling mechanism.

Its flexible rubber section has no pockets or restrictions which could in any way trap particles of putrescent material since the unit is self-scouring. It can produce a condition of complete cut-off if necessary or of complete wide-open maximum flow conditions.

The core of the device is a time-tested venturi tube with a throat section of flexible rubber. Differential pressure in the venturi is transmitted to a rate setter which measures and maintains the desired flow. If the flow tends to change, this meter actuates a motor-driven clamping device in the controller in order to adjust the flexible throat area. The unit measures the flow accurately and can be set over a wide control range.

## Foxboro Establishes New Instrument Firm in Mexico

The Foxboro Company, Foxboro, Mass., has announced the organization of a Mexican affiliate, Graficas e Instrumentos, S. A. A key link in Foxboro's world-wide network, the new firm, located in Mexico City, has been incorporated for the future manufacture and assembly of instruments and instrument supplies. Its engineers, graduates of Foxboro's extensive training courses, are well qualified for their duties and will handle all types of repair work, from simple adjustments to major overhaul.

The new concern has obtained factory facilities adjacent to Schultz y Cia., Foxboro's sales representatives in Mexico, establishing close co-operation between the two companies and insuring quick, convenient service for instrument users in Mexico. Already in full production is the chart department, printing Foxboro precision charts for all types of recording instruments.

Another
FIRST
FOR
SMITH-BLAIR...

NOW!
SMITH-BLAIR
*Ductile Iron*
TAPER SEAL
SERVICE CLAMPS!

For the first time, the amazing new material, ductile iron, is available in the complete line of Smith-Blair "Taper Seal" Service Clamps!

Ductile iron service clamps offer the important advantages of bronze — at less cost. They are stronger, more ductile — and have a corrosion resistance that is superior to malleable or cast iron.

Combined with the many advantages of the exclusive "Taper Seal" design — which makes possible a quick, easy installation with a more positive water seal — the Smith-Blair Ductile Iron Service Clamps set a new standard for the industry!

• *Write today for complete information:*

Another
FORWARD
STEP
For the
WATERWORKS
INDUSTRY

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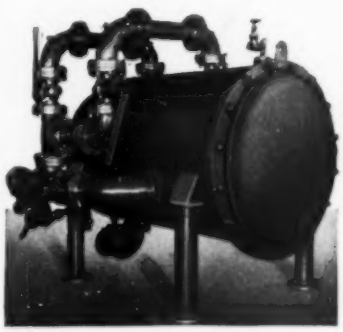
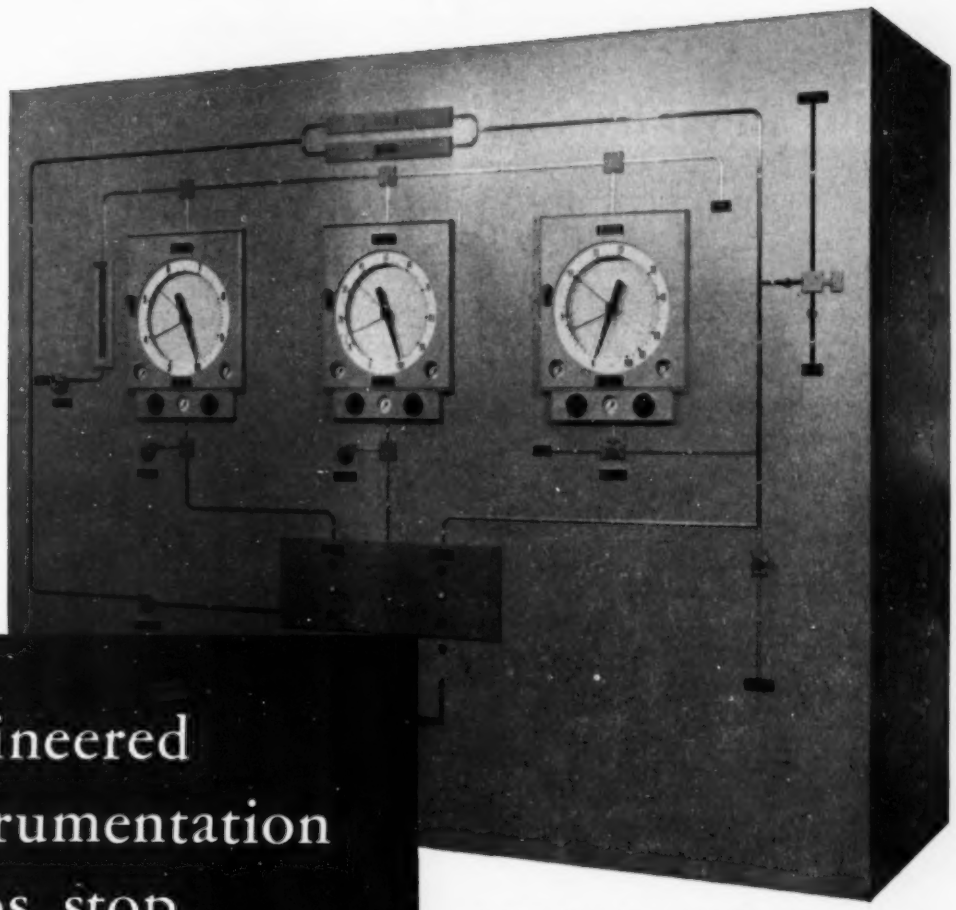


## New Type Filter for Plant Water

803

Sparkler Manufacturing Co., Mundelein, Ill., has introduced a new type filter employing diatomite filtering for plant water. The manufacturer states that now, the fine uniform filtering obtained with a surface type diatomite filter can be used for large volume water filtering with complete success.

This model SCJ filter has been in operation for about two years in many



# engineered instrumentation helps stop water corrosion

*30,000 gallons of water per minute are treated under the control of this instrument panel. Mounted on the graphic process diagram are* ***ElectroniK*** *instruments with* ***Air-O-Line*** *control, for regulating pH, sodium dichromate concentration, and total solids.*

IMPURITIES in raw water cause a multitude of troubles. However, through the application of modern water-treating methods—controlled by Honeywell engineered instrumentation—large volumes of water for plant use can be continuously processed to reduce these deteriorating effects to a minimum.

In the panel pictured above, three *ElectroniK* instruments team up to control the treating process. One of them adjusts pH by regulating the addition of sulfuric acid. The second works in conjunction with a Beckman flow colorimeter to control the addition of sodium dichromate, the oxidation inhibitor. The third instrument regulates blow-down to maintain a specified concentration of total solids. Together they provide complete, automatic control of the water treatment . . . reduce scaling, corrosion and biological attack . . . cut costs of chemicals and labor.

An unseen but important plus value here, as in many other installations, is the Honeywell engineering behind the job . . . which combined all the required control functions into an integrated, functionally designed *Colorgrafic* control panel. This same engineering experience, and Honeywell's complete line of instruments, are ready to work with you and your consulting engineer on any water or waste treatment project.

Your local Honeywell representative will welcome the opportunity to discuss engineered control . . . and he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4575 Wayne Ave., Philadelphia 44, Pa.

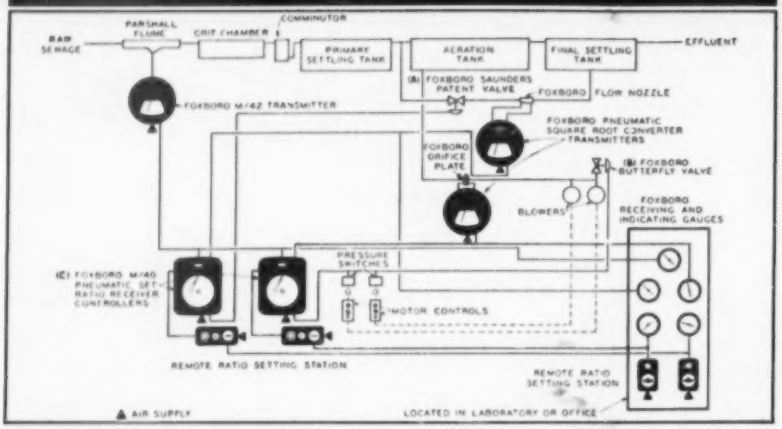
● **REFERENCE DATA: Write for Catalog 1550, "Measurement and Control of pH, Redox and Conductivity."**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

*First in Controls*

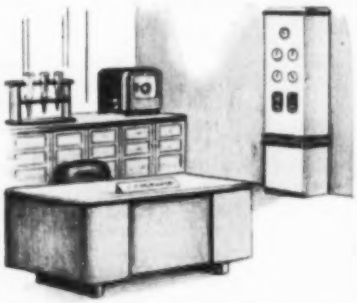
# How to reduce "Bulking" in your activated sludge process




Schematic diagram shows typical installation. Rate of return sludge is controlled by (A) Foxboro Pneumatically Operated Valve located downstream from a Foxboro Flow Nozzle. Air flow rate is controlled by (B) Foxboro Butterfly Valve on blower relief line with an orifice plate in discharge line. Both control valves are actuated by (C) Foxboro M/40 Receiver Controllers and provide a fixed ratio of influent to air and return sludge in the aeration tank.

THIS FOXBORO system of aeration and return sludge control *automatically* maintains desired ratios of influent to air and to return sludge. You just set the selector switches at the proper ratios and Foxboro Controllers take over . . . no manual operation of valves . . . no need for 24-hour operational watches . . . less danger of "bulking" in final settling tank, regardless of variations in influent rate. Moreover, the Foxboro M/40 Ratio Receiver Controllers give you a permanent, continuous operational record for your files.

Why not learn more about this modern Foxboro Control System . . . write for Application Engineering Data Sheet 833-9. **The Foxboro Company, 898 Neponset Avenue, Foxboro, Mass., U.S.A.**



Remote setting stations can be located in laboratories or office so that Chemists or Superintendent may change the ratio setting without going to the main instrument cabinet.

FOXBORO Reg. U.S. Pat. Off. ACTIVATED SLUDGE CONTROL


municipal water works and swimming pool installations and has proved its effectiveness and economy.

Operating engineers report that daily laboratory tests show that the filter will completely remove suspended matter either colloidal or solid, bacteria 80% to 100% depending on the type of bacteria and the grade of diatomite used. Thus reducing the required chlorination to a very low point.

Filters are available in sizes from 25 sq. ft. to 1000 sq. ft. of filtering surface. Flow capacities over 2½ M.G.D. per unit.

## Novel Pneumatic Well Seal

804

In the oil business there are well packers of every possible description designed to meet every conceivable condition. Water wells, because of their large diameters, are simply out of reach of such packers. However, General Pump Service, Inc., Los Angeles, have built several Pneumatic Well Seals (patents pending) for use in Southern California. The seal is integral with the column pipe and forms a short section thereof. It is simply a barrel shaped structure welded to the section of pump column with the center section replaced by a vulcanized rubber girdle that can be inflated or deflated through ¼" steel pipe from the surface. The seal when inflated is as here pictured.

Obviously the Pneumatic Seal is installed deflated and thereafter kept

# MANHOLE STEPS:

## GIVE THEM AN EXTRA MARGIN OF SAFETY WITH CORROSION-RESISTANT EVERDUR

Manhole steps—of all sewage treatment and waterworks structures—need *extra* corrosion resistance and dependability. Everdur* gives it to them . . . and adds the strength that really pays off . . . in greater safety.

Everdur Copper-Silicon Alloys deliver the same corrosion resistance—*plus ease and economy of operation over the years*—to gates, screens, guides and bolts, weirs, float chambers, troughs, stems and electrical conduit. Everdur is easily fabricated into lightweight, built-up wrought-metal assemblies.

Depending on type or composition, Everdur Alloys can be worked hot or cold. You can form, forge, weld and machine them. They are available in the form of plates, sheets, rods, tubes, electrical conduit and casting ingots.

Write today for Anaconda's free booklet, "Everdur Copper-Silicon Alloys for Sewage Treatment and Waterworks Equipment." For specific help in selecting the right alloy for your equipment, consult our Technical Department. *The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.* 5314D

*Reg. U.S. Pat. Off.

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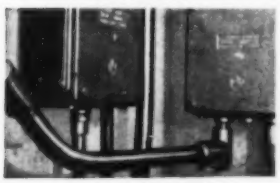
**COPPER-SILICON ALLOYS**

STRONG · WELDABLE · WORKABLE
CORROSION-RESISTANT

**CONDUIT**



**SCREENS**

**GATES**

**STEMS**

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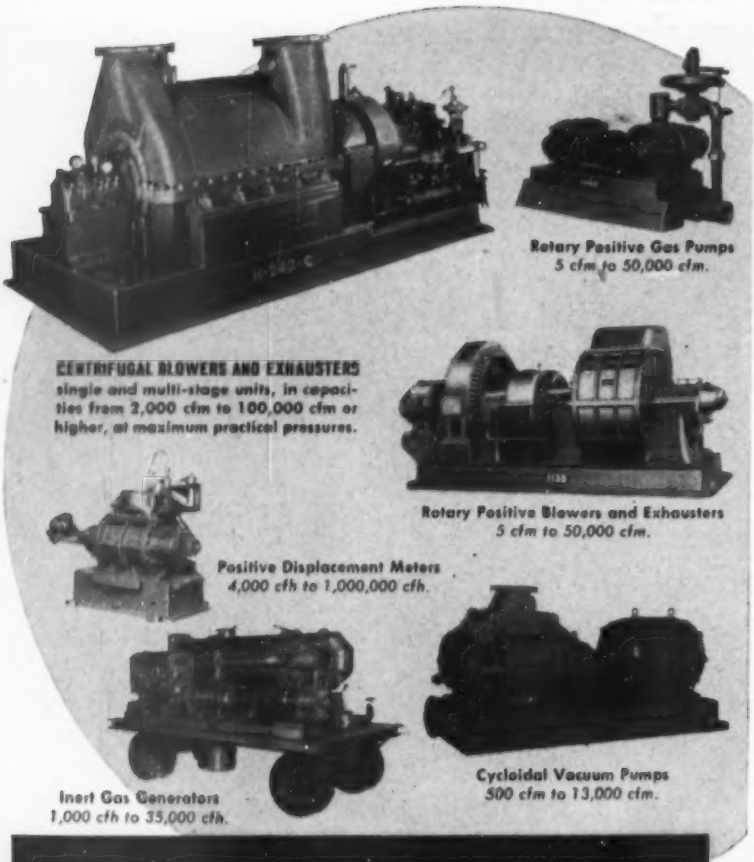
Rotary Positive Gas Pumps
5 cfm to 50,000 cfm.
CENTRIFUGAL BLOWERS AND EXHAUSTERS
single and multi-stage units, in capacities from 2,000 cfm to 100,000 cfm or higher, at maximum practical pressures.
Rotary Positive Blowers and Exhausters
5 cfm to 50,000 cfm.
Positive Displacement Meters
4,000 cfh to 1,000,000 cfh.
Inert Gas Generators
1,000 cfh to 35,000 cfh.
Cycloidal Vacuum Pumps
500 cfm to 13,000 cfm.

WE *Specialize* IN YOUR PROBLEMS OF MOVING GAS OR AIR!

You may need to move a thimbleful of gas . . . or create a cyclone of whirling air. Whatever your problem, we've probably met something close to it, in experience of almost a century of building such equipment.

Another reason why we know so much about this job is that it's all we do. Our customers range from the "giants of industry" to the neighborhood plant, both of whose production depends upon continuous, reliable, economical performance of air and gas handling units. Because we build the exclusive *dual-ability* line of Rotary Positive and Centrifugal Units, in a wide range of sizes, we offer a *dual choice* which permits completely unbiased recommendations.

So—if you have a problem today—or anticipate one a year or five years from now, we suggest you call upon the facilities of R-C Specialists. Write for bulletins on any specific equipment.

ROOTS-CONNERSVILLE
*Exclusive Specialists in Handling Gas and Air*

**ROOTS-CONNERSVILLE BLOWER**

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inflated during the period of use. Incident to removal it is deflated for easy handling.

Harvey A. Mylander, consulting hydraulic engineer of Pasadena, inventor of the Pneumatic Well Seal, cites as an illustrative and typical example the use of the Pneumatic Well Seal on the Azusa Well located east of Los Angeles and owned by the Southern California Water Co. The well was completed in 1944 to a depth of 446′ with 16″ casing installed. Eight separate producing zones were perforated in the usual manner. Last year the well began producing sand in such quantities that it was impossible to use the well another season. A study of each zone was made by the bailer-catch method. Upon comparing results it was found the upper 5 zones, down to 187′ were all producing sand. Below this production was clear. It was concluded that the upper 5 zones must be sealed and bids revealed the following cost comparison:

| | |
|---|---|
| Installing liners | $1,500.00 |
| Cementing | 750.00 |
| Pneumatic Well Seal | 450.00 |

The Pneumatic Well Seal was installed and the desired results obtained. Further information may be had by simply filling in one of the Reader Service postal cards to be found elsewhere in this issue.

H. V. Eastling

D. E. Thal

## Link-Belt Promotes Eastling and Thal

Link-Belt Company, Chicago, Ill., has appointed Harvey V. Eastling asst. general manager of its Pacific Division, with headquarters at San Francisco.

Mr. Eastling, heretofore general sales manager for the Pacific Division, started his Link-Belt career in 1925 as chief draftsman at San Francisco. He served as chief engineer at San Francisco; manager, engineering sales, at Seattle; and general sales manager of the Pacific Division.

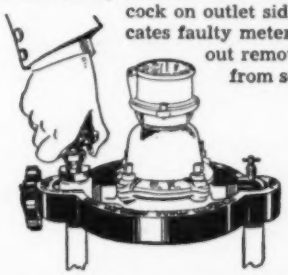
Also announced is the appointment of Donald E. Thal as sales manager of the San Francisco plant.

(*Continued on page* 96A)

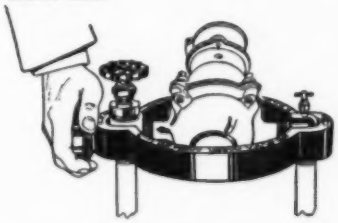
# Meter Installation And Removal Now Simplified

With the use of Clark Meter Yokes, installation or removal of meter is a simple job requiring only a few seconds' time. Only one hand is needed, assuring ample visibility in the box.

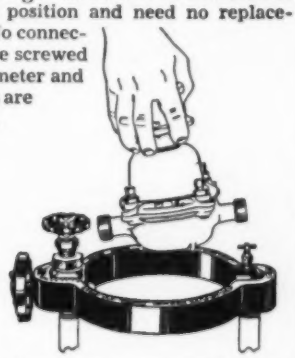
***Closing Valve.*** A few easy turns close the water-way without use of tools. Try-cock on outlet side indicates faulty meter without removing it from service.



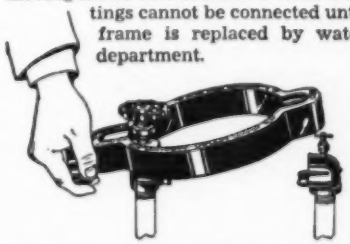
***Releasing Meter*** is accomplished with a few turns of handwheel. Meter tips and rests on yoke frame. It cannot fall over frame and drop to bottom of meter box.



***Removing Meter.*** Just lift out. Gaskets stay in position and need no replacement. No connections are screwed on the meter and no tools are needed.

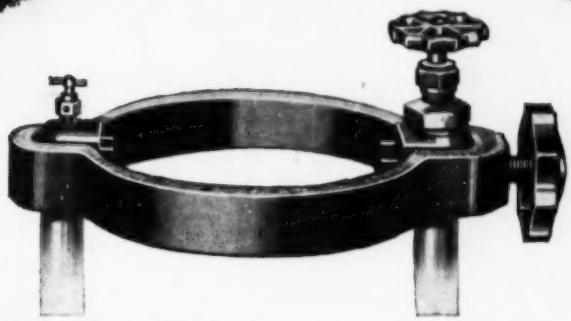


***Sealing Service*** is accomplished by removing frame of Clark Meter Yoke. Fittings cannot be connected until frame is replaced by water department.



For further details and features of these time-saving meter yokes, we suggest that you write the manufacturer, H. W. Clark Co., Mattoon, Illinois . . . mentioning this article and publication.


## CLARK METER YOKES
### For Easy One-Hand Operation



No. 4 CLARK METER YOKE. Installation is made without bolts, rivets or screws. Outlet try-cock ell determines condition of meter and inlet control valve ell facilitates easy exchange of meters.

Try-cock Ell

Valve Ell

Bronze Ell and Valve with Copper Connections.

SPACER CLAMP ties riser pipes together rigidly at bottom of meter box and automatically liberates meter when handwheel is loosened.

Thanks to simplified design and construction, Clark Meter Yokes permit easy one-hand operation. They are manufactured in a minimum number of sizes to meet every requirement of simplified operation. Because they eliminate so many parts, Clark Meter Yokes are also economical. Costs of meter couplings, curb stop, service box and several pipe fittings are saved. Circular one-piece cast iron frames give added strength, and these yokes are quickly installed on any type of service line. Available for either iron or copper pipe. To get all the details . . .

***Write***

## H. W. CLARK CO.
MATTOON, ILLINOIS

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.


*Here's why* — SEWAGE TREATMENT PLANTS *Modernize* WITH

**HOMESTEAD**

*Self-Seald...Lubricated*

**PLUG VALVES**

HOMESTEAD "SELF-SEALD" LUBRICATED PLUG VALVES controlling raw, recirculated and digested sludge at 15 lbs. to 20 lbs. working pressure to heaters, digesters, and drying beds in a Sewage Treatment Plant.

1. THEY'RE SELF-SEALING.
2. THEY AUTOMATICALLY ADJUST FOR WEAR.
3. HAVE 100% LUBRICANT SEAL AROUND PORTS.
4. USE LESS LUBRICANT.
5. THEY GIVE POSITIVE SHUT-OFF AND REMAIN DROP-TIGHT for extremely long periods of time.

Homestead's exclusive Self-Sealing feature combines the positive sealing action of the tapered plug with the free turning action of a cylindrical plug type valve. And because they are Self-Seald—*automatically adjust for wear as wear occurs*—they assure extra long, leakless service . . . more operations between lubrications . . . require less maintenance and materially lower plant operating costs.

More than 10 years of gruelling service in almost every type of industry has proved them to be the lowest-cost-per-year means of fluid control within their service range.

We make them in semi-steel or cast steel; 100% port area or Venturi type; sizes ½" to 14" for 200 lbs. oil-water-gas working pressures; in Straight-Way or Three-Way types for Wrench or Worm and Gear operation, with High or Low Head Extensions, and Hand Wheels or Floor Stands.

**Self-Sealing or one-piece plugs optional in Straight-Way type; 3-Way type has one-piece plug only. Complete data and prices on request.**

*Write today for VALVE REFERENCE BOOK No. 39-5*

**How the Amazing "SELF-SEALD" Principle Works**

Homestead's patented "Self-Seald" principle is, we believe, the simplest and most effective sealing principle yet developed for lubricated plug valves.

In addition to a full lubricant seal around the ports, and around the top and bottom of the valve, the wedge-action of the plug under line pressure causes the finely-finished surfaces of the plug to press outward against the sealing surfaces of the body.

This self-sealing action keeps the plug surfaces in contact with the bore of the body. The plug automatically adjusts itself for wear, thus assuring extra long life and maximum leakless service.

**HOMESTEAD**

VALVE MANUFACTURING COMPANY

*"Serving Since 1892"*

P. O. BOX 41 — CORAOPOLIS, PA.


Mr. Thal studied mechanical engineering at the University of Illinois and Massachusetts Institute of Technology, and has since 1935 been employed in Link-Belt engineering departments at the Caldwell plant in Chicago, the Seattle plant and the San Francisco plant. He has more recently served as asst. sales manager at San Francisco.

## New Sectional Customer Service Counter

805

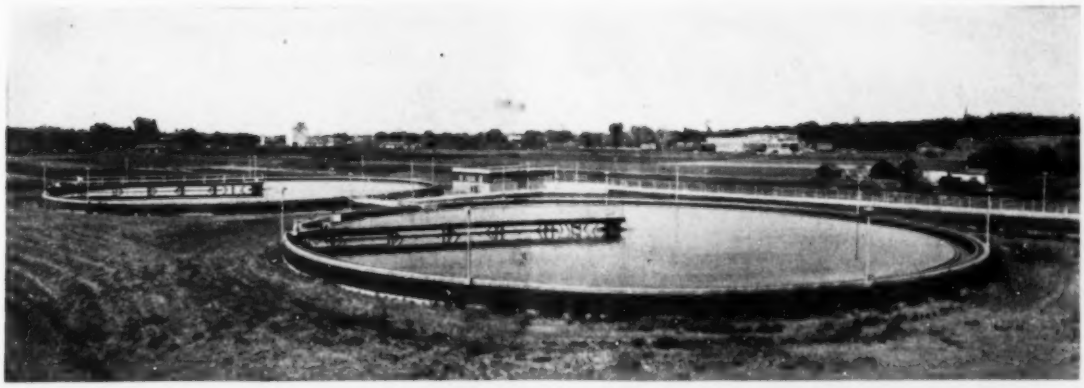
Remington Rand, Inc., New York, N.Y., has developed a sectional customer service counter for public utility offices. The new counter centralizes all customer contacts and records by combining the usual counter, safe and desk.

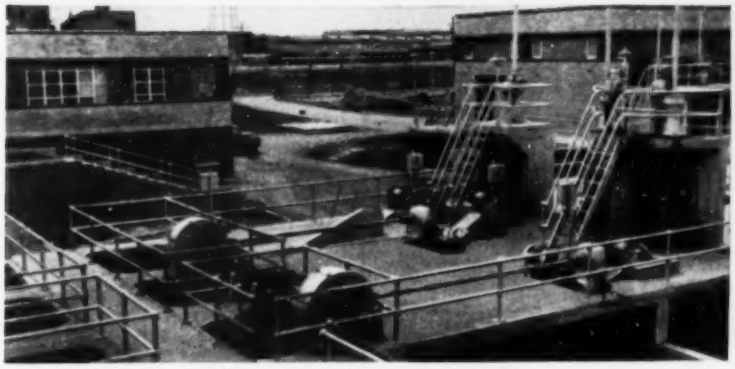
In the small office, operations are combined at one sectional counter unit to enable one clerk to carry on the functions of cashiering and bookkeeping. In the larger office several units can be combined to form a compact business-engineered Customer Service Station. A quarter round unit can be made to order for those offices in which a right angle arrangement of counters is desired. Extension tables can be provided for a comfortable contact desk at which a customer may be seated, while desk-height insulated units provide point-of-use protection for valuable accounting records.

## Pittsburgh Coke Appoints 7 Distributors

The Protective Coatings Division of Pittsburgh Coke & Chemical Company, Pittsburgh, Pa., recently announced the appointment of seven companies throughout the country as distributors for its Pitt Chem Series 100 Coal Tar Coatings.

The appointments are part of a recently instituted program to insure that Pittsburgh Coke & Chemical Company's heavy duty maintenance coatings are more readily available





Link-Belt Circuline sludge collectors, mechanically-cleaned bar screens and Straightline grit collector help provide 114 mgd peak load capacity at Denver sewage treatment plant. Black & Veatch, Consulting Engineers.

# Denver adds 30 mgd of efficient sewage treatment capacity

## LINK-BELT screens, sludge and grit collectors chosen for the job

FACED with growing population and increased industrial activity, the city of Denver recently enlarged its North Side sewage treatment plant from 54 to 84 mgd design capacity. And, as in so many other municipalities, Link-Belt equipment was specified for the major share of the work. Each of the Link-Belt units contributes greatly to dependable, efficient operation:

- Link-Belt mechanically-cleaned bar screens collect large floating solids, are easily kept clear to assure even flow.
- Link-Belt Straightline grit collector, 60x8x10 ft., settles and effectively collects the grit, keeps organic material in suspension so that it passes through the chamber.
- Two 150-ft. diameter Link-Belt Circuline sludge collectors provide quick, positive sludge and scum removal in the shortest time—without septicity . . . without maintaining any sludge blanket and with a sludge solids content as high as 13%.

The equipment used at Denver is part of the complete Link-Belt quality line. Our sanitary engineers will be glad to work with your engineers, chemists and consultants to give you the best in modern water, sewage or industrial liquids treatment equipment.

**LINK-BELT COMPANY:** Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices in Principal Cities. 13,273

**LINK BELT**

**SANITARY ENGINEERING EQUIPMENT**

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*Everything's under control—*

*WITH*

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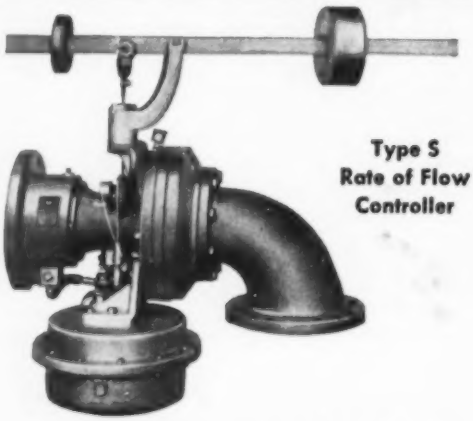


Type S
Rate of Flow
Controller

**ACCURATELY CONTROLS RATE OF FLOW OVER LONG RANGES!**

Of the most advanced, proven design, Simplex Type S controllers meet all requirements of modern filter plants! Look at these unmatched advantages:

- Compact design, low weight
- Small overall dimensions
- Ball bearing mounted valve shaft
- Hydrostatically balanced, patented guillotine valves
- Horizontal or vertical installation
- Simple direct action design
- Venturi tube type of differential pressure producer
- Quick starting from open position
- Response to slightest differential pressure
- Extreme accuracy of control over long ranges

For bulletin with full information write to the Simplex Valve & Meter Co., 6743 Upland Street, Philadelphia 42, Pa.

**SIMPLEX®**

SIMPLEX VALVE & METER CO.

throughout the country, wherever the demands of industry for protection against corrosion, moisture, weather and detrimental vapors or liquids indicate their use.

The seven firms recently appointed are:

W. A. Case and Son Manufacturing Company, Buffalo

Detroit Paint and Glass Company, Detroit

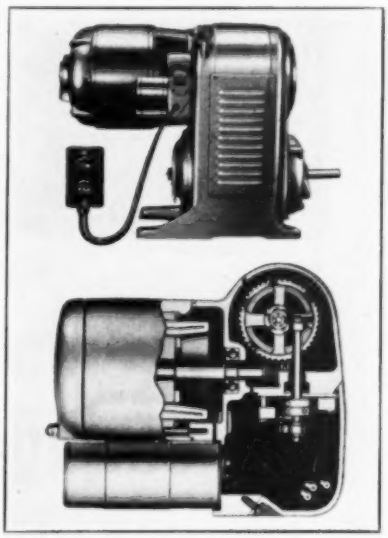
Minnesota Cem-Steel Company, Minneapolis

H. D. Fowler Company, Inc., Seattle

Anti - Corrosion Manufacturing Company, Atlanta

S. D. Day Company, Houston

Bodwell-Lemmon Supply Company, Cleveland

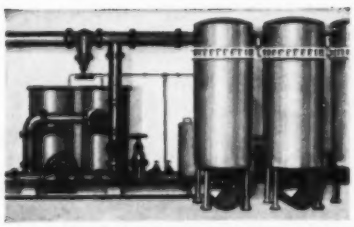


## Remote Control Motor Operates Variable Speed Motor

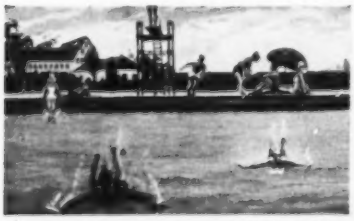
806

U. S. Electrical Motors, Inc., Los Angeles, California, has developed a totally-enclosed auxiliary motor to provide a positive electrically-driven control for U. S. Varidrive motors. It is called the ERC remote control motor. It is compactly attached to the Varidrive, replacing the control handle, and is operated by a push button. This auxiliary motor is ruggedly designed and is 1/15 horsepower, 1800 rpm, of the reversible capacitor type. It has a low inertia rotor for quick stops. Its rugged worm drive actuates the Varidrive's speed control shaft as well as the adjustable limit switches. The connection box is an integral part of the unit. By use of the ERC unit, the Varidrive can be operated from a control station distant from the motor.

# CELITE FILTRATION produces clear sparkling water . . . even removes chlorine-resistant organisms



**In municipal water works**—engineers find that a Celite Diatomite Filtration System permits lower capital investment plus high operating efficiency. Filtration is extremely thorough, the filter cake can withstand many times the pressure of an ordinary filter bed. No pH control is necessary with Celite.



**In swimming pools**—operators find that Celite Filtration not only safeguards the purity of pool water, but it provides sparkling clear, inviting water—an important asset in attracting customers. With Celite Filtration, there is a continuous recycling of water at fast flow rates, and the need for chemical treatment is reduced.

Celite* Filtration removes even the finest suspended solids such as amoebae and algae—many of which cannot be filtered by other means. All these impurities are entrapped by Celite's almost infinite network of tiny porous particles . . . thus reducing the need for chemical treatment. Celite offers many other advantages, too . . . it permits important space savings in the installation, high flow rates are maintained, and far less backwash water is required for cleaning the system.

Carefully processed from the purest deposits of diatomaceous earth, Celite is available in nine standard grades. Each is designed to filter out suspended impurities of specific size and type. Utmost uniformity of product is maintained, so that whenever you reorder, you are assured of the same accurately graded powder.

Municipal water works engineers, food processors, beverage manufacturers, swimming pool operators . . . all who require "drinking-pure" water, can benefit from filtration with Celite Filter Aids. It will pay you to investigate the many advantages of Celite for your particular requirement! To have a Celite Filtration Engineer study your problem and offer recommendations, simply write Johns-Manville, Box 60, New York 16, New York. In Canada, 199 Bay Street, Toronto 1, Ontario. No obligation or cost.

JOHNS MANVILLE JM PRODUCTS

*T.M. Reg. U. S. Pat. Off.

## Johns-Manville CELITE FILTER AIDS

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# STEVENS

**TYPE B-FT RECORDER PROVIDES PERMANENT DATA ON SEWAGE FLOW**

**At this modern sewage treatment plant in Dallas, Oregon, the STEVENS Type B-FT Recorder provides a permanent graphic record of flow in million gallons per day (range 0-6 MGD) and totalizes the volume in gallons. The STEVENS Recorder is mounted over a stilling well connected to a 9" throat width Parshall flume.**

## record flow accurately . . . automatically

There is good reason why modern municipal sewage and industrial waste measuring installations use the STEVENS Type B Recorder. It may be wall, pedestal or panel mounted, is easily operated and will give a lifetime of accurate, trouble-free service. This Recorder uses a circular chart which makes one revolution per day or per seven days, as specified, while the pen swings in an arc around an external center—the combined movements thereby producing a graph of the rate of flow (or head) against time. Volume is indicated on a counter-type totalizer. Accuracy of the registration is limited only by the accuracy of the rating to which the totalizer is set. Flow or head (or both) may be indicated on a scale clearly visible through a large glass port.

**RECORDS FLOW**
**RECORDS HEAD**
**TOTALIZES FLOW**
**Direct Float Operated or Remotely Controlled**

To find out more about the STEVENS Type B Recorder, and how it can simplify the task of compiling accurate flow records, write for FREE Bulletin 25.

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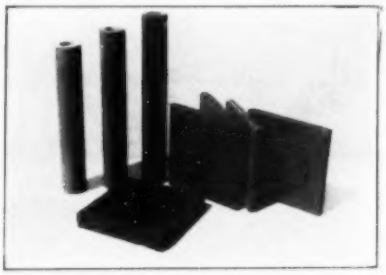
## Chain Belt Promotes W. N. Konrad

Chain Belt Company, Milwaukee, Wis., has announced the appointment of W. N. Konrad as Product Supervisor for its line of Rex Sanitation Equipment.

A native of East Chicago, Indiana, Mr. Konrad graduated from Purdue University where he majored in Sanitary Engineering. He started with Chain Belt Company in 1948 as a student engineer and previous to his most recent appointment, worked as a sales engineer in the Sanitation Division.



## Synthetic Bond Quartz Air Diffuser Plates and Tubes

807

Filtros, Inc., East Rochester, N.Y., have developed an improved type of highly porous air diffuser plate using a strictly classified round shaped quartz grain and a synthetic bond. These air diffusers offer a considerably lower air resistance than ceramically fritted plates at equal or smaller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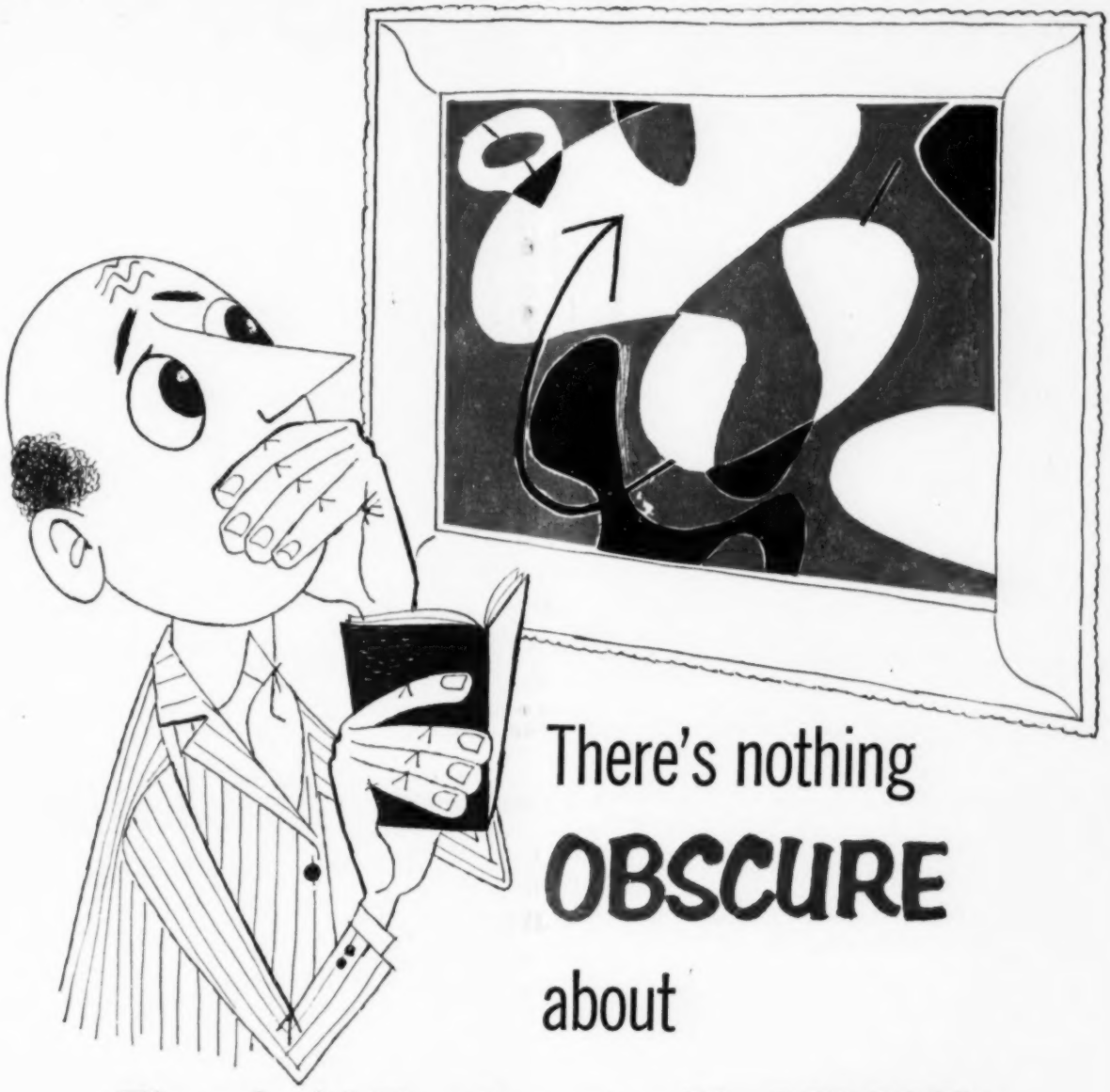

# There's nothing **OBSCURE** about Threshold Treatment with **CALGON***

JUST SIMPLE FACTS tell the story about Threshold Treatment with Calgon. The treatment is effective and economical. Threshold Treatment with Calgon prevents lime scale. It controls corrosion. It stabilizes dissolved iron and manganese, and it stabilizes water following softening.

We have helped many users of municipal and industrial waters solve their problems. Let us help you.

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Mathematical accuracy—not guesswork—enables you to determine the exact chemical dosage with the Electro-Magnetic Proportioner, the heart of all AMERICAN Chemical Feeders . . . No other chemical proportioner on the market can compare with it for *accuracy, simplicity, durability* or *dependability! Unconditionally guaranteed for Five Years!*

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AMERICAN Chemical Feeders offer you better continuity—with impulses every 15 seconds or less . . . American Chemical Feeders are built to last—and they do! Some have given satisfactory service for more than a quarter-century!

The AMERICAN Electro-Magnetic Proportioner has wide application as the basic unit on all lime-soda softeners—cold or hot process. Any water-treating plant can take advantage of its accurate, automatic proportioning of chemicals. It is often used to modernize old plants, as well as to solve problems in new plants.

*Write for complete details today.*

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**AMERICAN *Water Softener* COMPANY**
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pore size ranges, thus contributing to economies in air supply, an important feature in the maintenance of sewage treatment plants. Further advantages of this new type of material are (a) high mechanical strength and (b) algae and fungicide properties due to the round shaped grain and the kind of binder used. Plates have been made in 40, 60 and 80 permeability and tubes in the conventional sizes for suring type and other diffuser arrangements in activated sludge will be available soon.

A similar type of plate has been used in Germany over a considerable length of time in most of the German activated sludge sewage treatment plants, such as Berlin-Wassmannsdorf, Ruhrverband, Essen and others, where they are operating with good success.

Plates of this type are also successfully used as underdrain plates for gravel bed water filters where mechanical strength requirements are very severe.

## New, Modern Plant for Detectron Company

The Detectron Company has announced the completion of their new factory in North Hollywood, California. The new plant represents the first phase in Detectron's long range expansion program—designed to meet the rapidly growing demand for scientific measurement and detection instruments.

The modern, one story building more than doubles the present production capacity of the company. At the same time, the new quarters will provide greatly enlarged research and development facilities—enabling De-

(*Continued on page* 104A)

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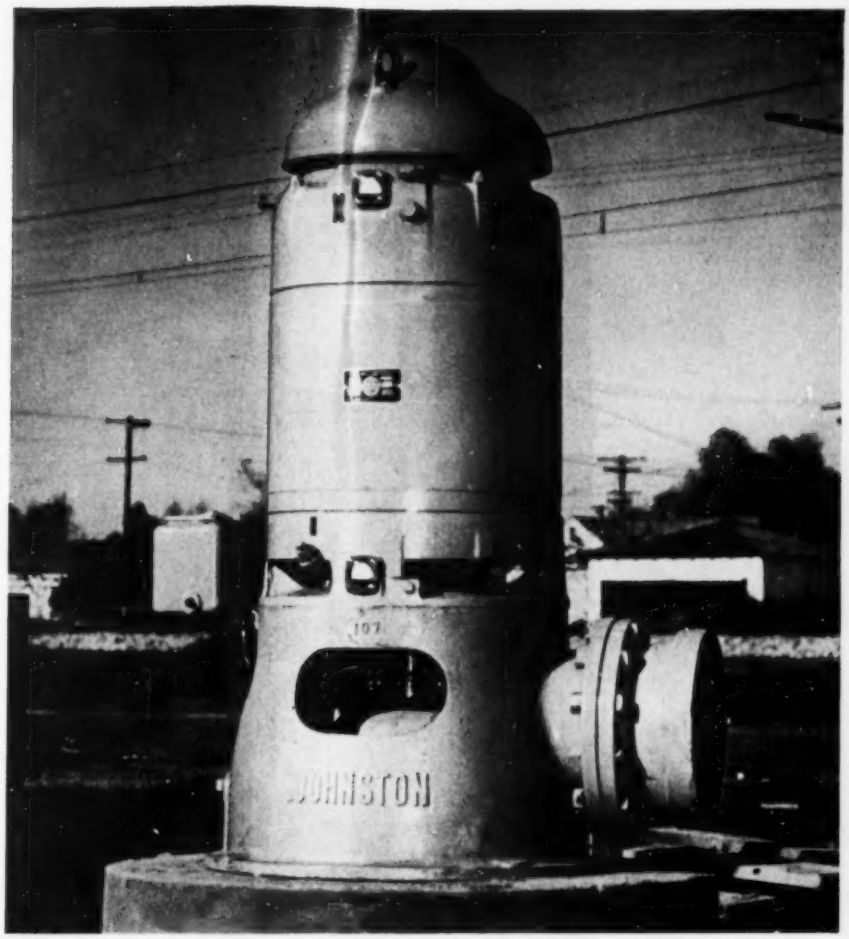
**Will see that you receive information desired.**

**In small cities and large...**




# JOHNSTON VERTICAL TURBINE PUMPS ARE SERVING MUNICIPAL WATER SYSTEMS

The City of Lynwood, like many California communities, has been faced with expanding water requirements in recent years due to a fast-growing population.

Located over a good groundwater reservoir, Lynwood naturally depends on deep wells for a majority of its water supply. Many pumps, like the Johnston pictured here, deliver the supply directly into the city mains, a job that is *really tough* on pumps. Not only must the pump operate with month-after-month dependability...at high sustained efficiency with low operating cost; but also must withstand constantly fluctuating heads without overloading the motor.

The Johnston Pump selected by Lynwood engineers, is a 125 horsepower unit, delivering 1500 gallons per minute from a depth of 140 feet, against a 250 foot total head. Worth noting is the fact that an independent organization employed by the City rated the pump at 74% overall efficiency in the acceptance tests... a bonus of 4 points over Johnston's guaranteed rating of 70%.

This is another typical example of the ability of Johnston equipment to handle tough pumping jobs. Why not let our trained engineering staff consult with you on the best solution to YOUR particular problem?

*Send today for your free copy of our bulletin, WATER—WHERE YOU WANT IT . . . WHEN YOU WANT IT. Ask for Bulletin K-83.*

JOHNSTON VERTICAL PUMPS

**JOHNSTON PUMP COMPANY**

**3272 E. FOOTHILL BLVD. PASADENA 8, CALIFORNIA**

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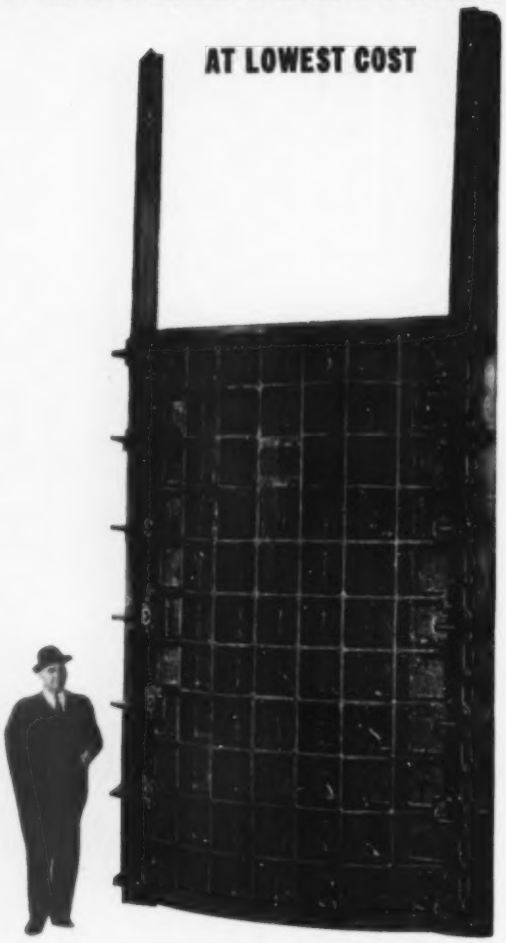

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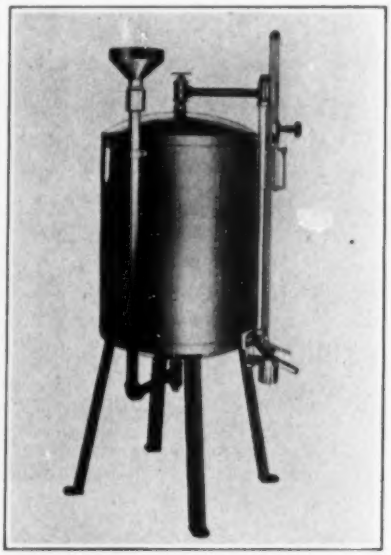
tectron's well-staffed engineering department to offer an expanding service for the design and production of custom and new electronic equipment.

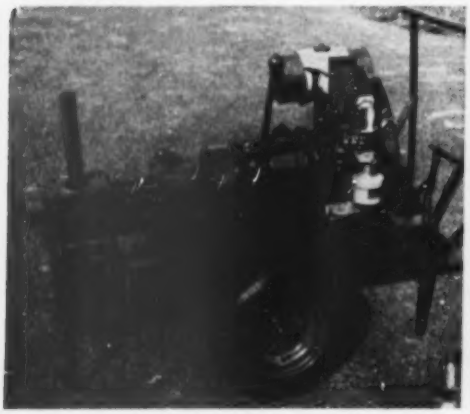
Completely modern throughout, the new plant features air-conditioning for both factory and offices and scientifically planned lighting that assures the necessary high efficiency required in the production of precision instruments. Space has been allotted for customer as well as employee parking. Additional adjoining property has been acquired with an eye to future expansion plans.



## Hankison Liquifeeder

808

Hankison Corporation, Pittsburgh, Pa., has developed a new gravity type liquid feeding device, embodying a new patented principle of control. Known as the Liquifeeder, it maintains a constant rate of feed, and is adjusted by a valve that meters the

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# pull a plug

Every drop of the millions of gallons of water a day pumped into homes, stores, plants and offices must also be disposed of. Pull a plug, or open a drain, and waste . . . sewage and water are gone.

Gone, but not disposed of. For it takes a lot of pumping to boost the flow on its way through a modern sewage disposal system.

Fairbanks-Morse 2-cycle Diesels have supplied that power for more than 50 years. Superintendents of F-M pumping plants know that they have the flexibility to meet the problem of changing dynamic heads—the problem of heavy loads imposed on the system by flooded storm sewers. And many times the sewage gas volume is great enough to make major savings in fuel costs with an F-M Dual Fuel engine.

Why don't you ask for the engineering assistance of a Fairbanks-Morse Municipal Power Specialist to help solve your sewage pumping problems. Fairbanks, Morse & Co., Chicago 5, Illinois.

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"O" Rings replace conventional packing and reduce maintenance to a minimum. The lower "O" Ring is the pressure seal, the upper "O" Ring the dirt seal. The specially compounded rubber plastic "O" Rings do not deteriorate and insure a long life pressure seal.

All Smith Valves can be equipped with "O" Ring Seal Plates. Write for details.

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air admitted to the supply tank. There is no restriction to the flow of liquid, yet the feed can be varied from less than one-half pint a day to more than 500 gallons a day. Each Liquifeeder includes a combination sight glass and bubble type flow meter. The rate of liquid feed is indicated by the bubble frequency in the sight glass.

Liquifeeders can be constructed of material to suit specific fluids. All parts subject to corrosion are made of stainless steel with teflon gasketing. Liquifeeders can be made in any size required by the user, and range from one quart to hundreds of gallons.

## Builders-Omega Move Mid-Western Office to Chicago

Builders - Providence, Inc., and Omega Machine Co., Providence, R. I., has announced that their midwestern sales office and service center, formerly located in Wilmette, Illinois, has been moved to 2039 West Howard Street, Chicago, Illinois.

According to the company there will be no change in personnel resulting from the move. Mr. George H. Jewell will operate from his new office as will Mr. Gerald E. Riepe, Manager of the midwestern territories, and his entire sales and service staff. Address of local representatives in Moline, Illinois; Kansas City, Missouri; St. Louis, Missouri; Minneapolis, Minnesota; and Omaha, Nebraska will not be affected by this move.

### Hard to Understand

Some folks look askance at the water works man who tells them that what makes water hard is the lime that's in it; and, to remove the lime from water, it is necessary to add lime. Another case of "fighting fire with fire."

BELL JOINT LEAK CLAMPS

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Also Anchored Glands for mechanical joints to replace socket clamps.

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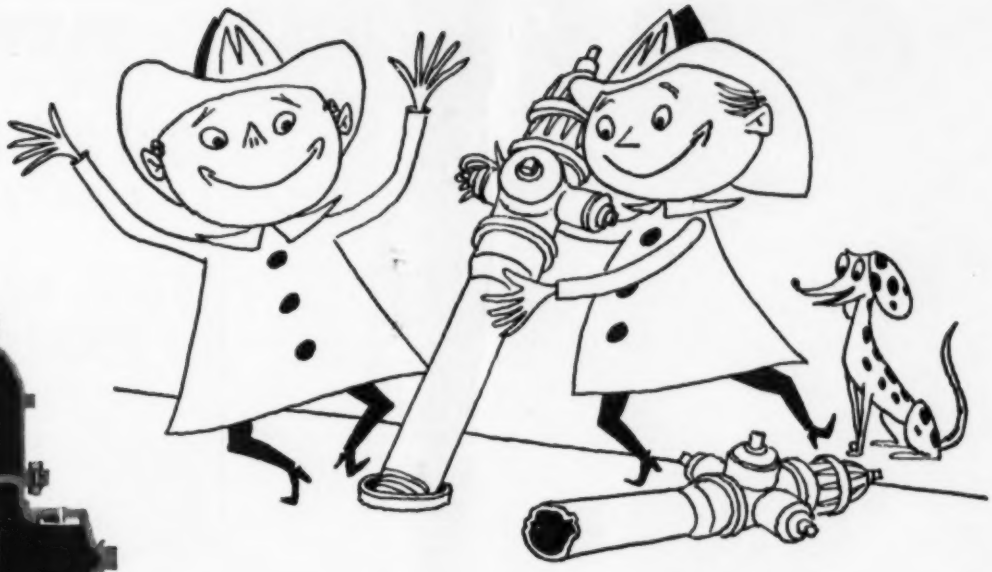

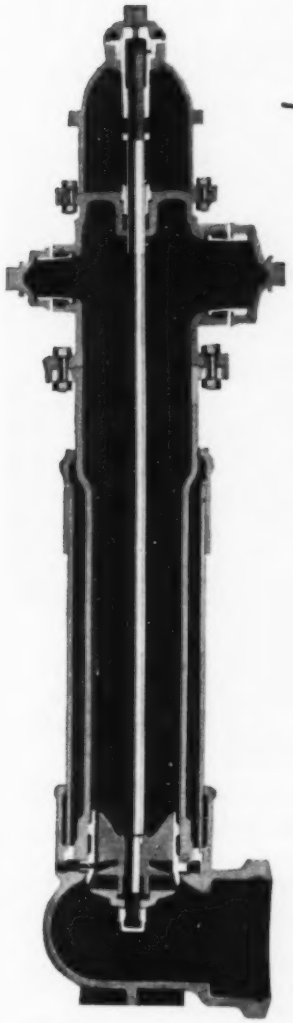

## No other hydrant is so inexpensive to maintain— so quick and so easy to repair

- **The Mathews Hydrant is so simply and soundly constructed that there's virtually nothing to go wrong.**
- **Only one point needs lubrication—the operating thread—and that only during routine inspections.**
- **A Mathews Hydrant broken in a traffic accident can be quickly repaired *without excavating* and nozzle levels can be adjusted with the same ease.**
- **For community fire protection, rely on Mathews Hydrants, the standard of the industry.**

# MATHEWS HYDRANTS

**Made by R. D. Wood Company**

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Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

**NO OTHER HYDRANT OFFERS SO MANY ESSENTIAL FEATURES**—Compression type valve prevents flooding • Head turns 360° • Replaceable head • Nozzle sections easily changed • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • All operating parts contained in removable barrel • A modern barrel makes an old Mathews good as new • Available with mechanical-joint pipe connections

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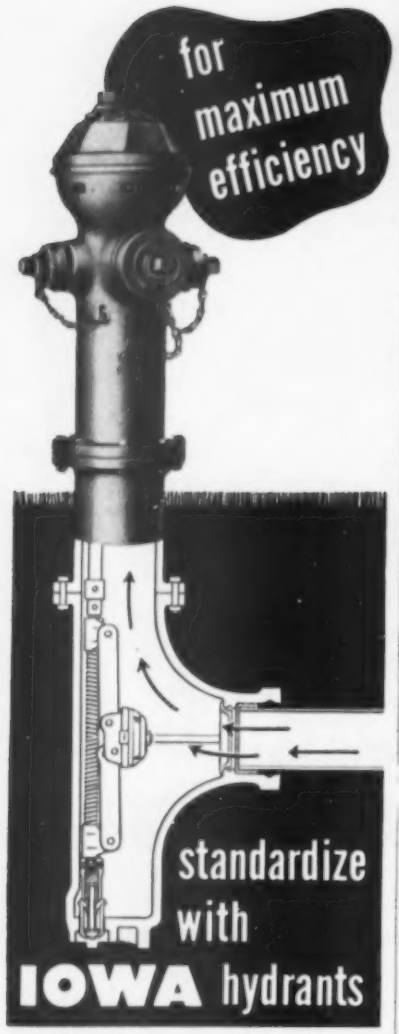


- **Two piece** operating nut with special adjustment screw solves the problems of expansion and contraction . . . makes Iowa hydrants easy to operate at all times.
- **Positive** operating mechanical drain valve can be removed along with all other working parts through top of hydrant without special tools.
- **Fixed position** of valve arms makes leaking impossible should standpipe be broken.
- **Unrestricted** water flow gives full pressure at extreme low loss of head.
- **Built** to conform to the latest A. W. W. A. specifications.

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## Literature & Catalogs

### Rodney Hunt Produces 250-Page Catalog On Water Control Apparatus

809

Rodney Hunt Machine Co., Orange, Mass., has published a 250-page 8½"x11" comprehensive catalog showing the full scope of **Rodney Hunt Water Control Apparatus.** Over a year in the making the catalog consists of eight sections; sluice gates, timber gates, hoists, fabricated gates, racks and rakes, valves, engineering data. Included are hundreds of diagrams, photographs with detailed descriptions, and specifications. The catalog is printed in color and attractively bound in permanent hard cover.

As an example of the catalog's completeness, the section on sluice gates alone covers 2,000 combinations of standard types and sizes; with special design features, applications, uses and advantages, installations and specifications comprising 16 chapters. These chapters are devoted to Rodney Hunt's 100, 200, 300, 400 series of cast iron, bronze-mounted sluice gates. In addition to the 2,000 combinations outlined, Rodney Hunt engineers are prepared to meet special sluice gate needs requiring custom design.

An important feature is the 28-page section devoted to engineering data and tables for water control There are seven main subjects covered; Determining Sluice Gate Size; Flow of Water in Pipes; Measuring the Flow of Water; Manning's Formula for Flow of Water in Open Channels; Hydraulic Data; General Data. Included under general data


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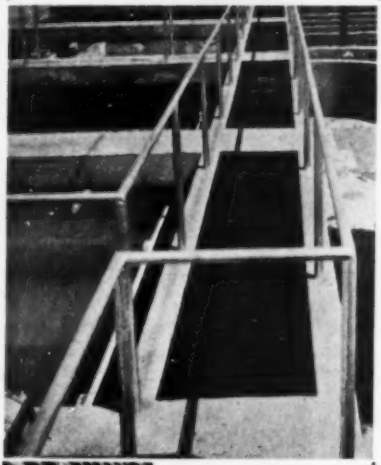

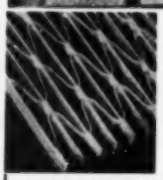

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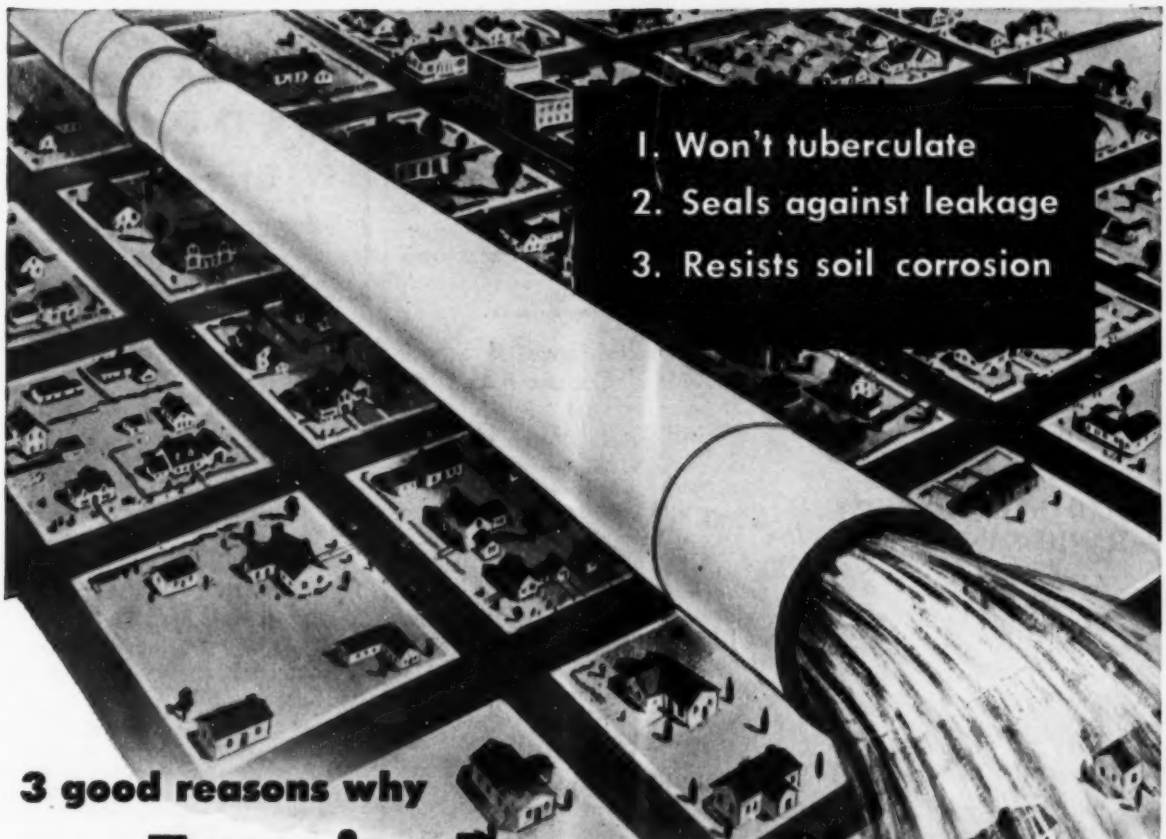


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# Transite Pressure Pipe reduces maintenance costs

For community water systems Johns-Manville Transite* Pressure Pipe keeps maintenance costs down to a minimum, while providing outstanding installation and performance advantages.

Transite asbestos-cement Pressure Pipe has a smooth inner surface which gives the pipe an initially high flow capacity. What's more, this capacity (C=140) can never be reduced by tuberculation, the form of internal corrosion which so often results in costly periodic cleaning.

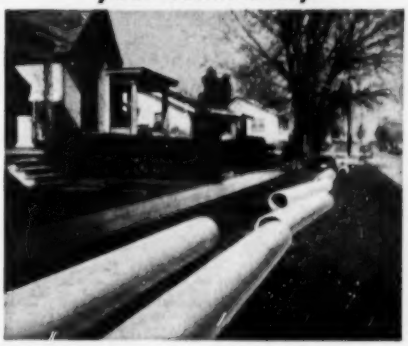
Transite Pressure Pipe is highly resistant to soil corrosion. It is entirely unaffected by electrolysis. And it reduces water losses because its factory-made, easily assembled joints stay tight in service.

Transite Pressure Pipe can save in other ways. It often permits the use of smaller pipe sizes, because systems can be designed without allowance for future flow reduction due to tuberculation. It is light in weight, easy and economical to install. And, because it maintains a full flow of water over the years, pumps can be operated at high efficiency, pumping costs held to a minimum.

For additional information, send now for your copy of Transite Pressure Pipe folder TR-78A. Write Johns-Manville, Box 60, New York 16, N. Y.

*Transite is a Johns-Manville registered trade mark.

**A sound investment for your community**



**The savings** Transite Pipe has effected because of its corrosion resistance, high flow capacity and long life are being realized today by thousands of municipal water systems and Federal, state and industrial installations throughout the country.

**Johns-Manville TRANSITE ASBESTOS-CEMENT PRESSURE PIPE**

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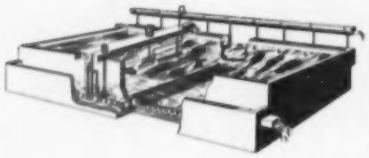
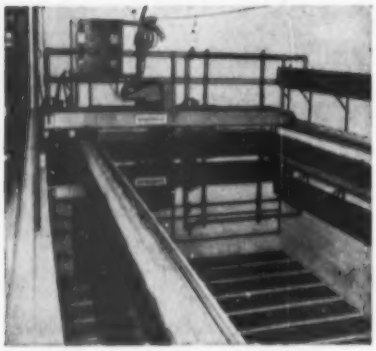


*Investigate the*
**AUTOMATIC BACKWASH RAPID SAND FILTER**



Here is a sand filter which cleans itself—automatically—with no interruption whatever to the filtering operation; No shutdown or change-over is necessary while cleaning is in progress.

The secret lies in its special, compartmented filter bed and traveling backwash mechanism which automatically cleans one compartment at a time.

May be used for plant supply water or for waste water treating. Write for Bulletin 46-A-15.

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are ten pages covering such useful information as: conversion factors, electrical formulae, weight and specific gravity of various materials, weights and areas of round steel and bronze bars, pipe data, miscellaneous formulae.

The catalog is offered without obligation, but only to consulting engineers, contractors and others actively engaged in water control construction work.

## Corrosion Resistance of Copper and Copper Alloys

810

The American Brass Company, New York, N. Y., has just published a booklet on **Corrosion Resistance of Copper and Copper Alloys.**

The new 28-page booklet is a result of 27-years of continuous laboratory research and field study of the nature of corrosive attack on copper and copper alloys. It explains the chemical and physical nature of corrosive attack in its various forms.

Included is a tabulation indicating the relative corrosion resistance of the principal types of copper and copper base alloys when in contact with 183 different corroding agents. The new booklet also gives more complete information on stress-corrosion cracking, galvanic corrosion, fresh and salt water corrosion.

## Model 110 Trencher

811

The Cleveland Trencher Co., Cleveland, Ohio, has just published a new 2-color, 8-page catalog-type bulletin on the **Cleveland Model 110 Trencher.**

The new bulletin particularly features the wide versatility of the Model 110. Numerous job applica-

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**SODIUM FLUOSILICATE**
*(Silico Fluoride)*

**Inquiries Invited**

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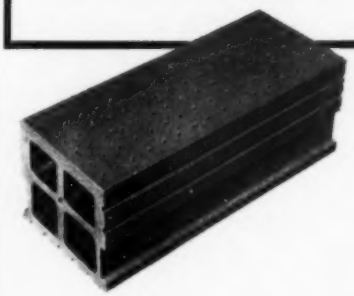
**LEOPOLD**
**Glazed Tile**
**FILTER BOTTOMS**



**PERFORMANCE PROVED IN OVER 200 PLANTS WITH A DAILY CAPACITY OF MORE THAN 900 MILLION GALLONS!**

With its many exclusive advantages, the Leopold Compound Duplex Filter Bottom provides the most practical and economical answer to your underdrain problems.

In this design, laterals and distributing blocks are combined in one permanent unit that insures uniform filtration over the entire filter bed and equal distribution of the wash water with minimum loss of head. The individual blocks—each about two square feet in area and weighing approximately 100 pounds—are made of highest quality de-aired fire clay, vitrified and salt glazed. They resist corrosion, are not subject to tuberculation, won't absorb any detrimental amount of water, and are impervious to acids and alkalis.

Adaptable to any rectangular filter unit, the efficient Leopold Filter Bottom needs only a shallow depth of small sized filter gravel to support the filtering medium. Further, the Leopold design does not require special supporting concrete members or the added concrete construction of a false bottom.

**Complete Water Purification and Sewage Plant Equipment . . .**

- **DRY CHEMICAL FEEDERS**
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**F. B. Leopold Co., Inc.**
**2413 W. Carson Street**
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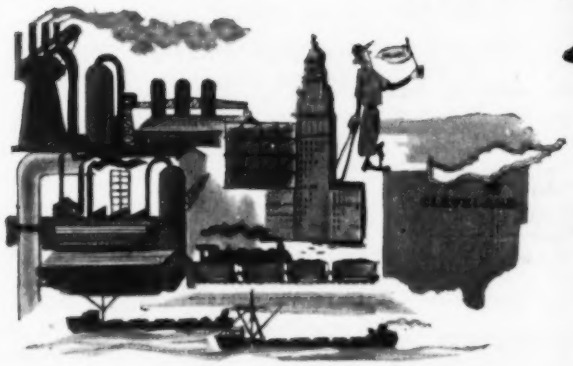
# Cleveland Prefers Concrete Pressure Pipe



Economy was a decisive factor in Cleveland's selection of concrete pressure pipe for its water supply system. This seventh ranking city in the nation, with an average daily water consumption of 272 mgd., found that the low original cost of concrete pressure pipe, together with its remarkably long life and excellent flow characteristics, made it a sound investment.

In 1940 the first concrete pressure pipe was laid in Cleveland. Since that time several additional installations have been made, one of these being the Nottingham intake. Here, 10,000 feet of 120 inch concrete pressure pipe was used. Just recently the Northfield Road Main was completed. This job, stretching for over 4 miles, used concrete pressure pipe in diameters ranging from 30 to 42 inches.

Efficient, economical concrete pressure pipe is available in a wide range of diameters and can be installed to fit the individual requirements of large or small communities.

*Water for Generations to come*

**Concrete PRESSURE Pipe**

**AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION**
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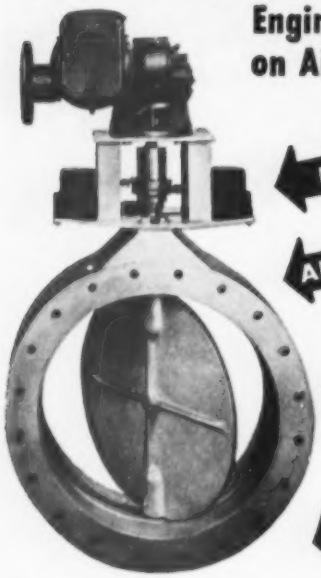

**FULL FLOW** with minimum pressure drop.

**ANY CONDITIONS** of commercial, drip- or bubble-tight closure, with quick, positive control and shut-off manually or automatically.

**RESISTANT** Made ruggedly for all conditions of corrosion, erosion, temperatures to 2000° F., pressures to 300 p.s.i.

**ALL TYPES** Butterfly, wafer or slide valves, 1" to 120" pipe size.

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CONTROLS that are dignified by a background of long experience and infallible operation. *ROTO-TROL* 940 controls pumps, valves, alarm circuits, etc., from one float. Starting and stopping positions, rising and falling, can be set as required. Each circuit is independent. Mercury switches with snap action are used. *ROTO-TROL* 940 can be easily set on the job.

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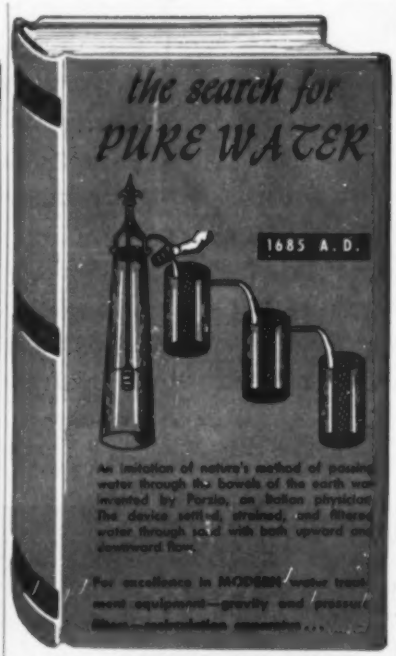



MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

**ROBERTS FILTER MFG. CO.**

607 Columbia Ave.

Darby, Pa.


tions within the trench size range of the 110 are illustrated. Cleveland design and construction features are accurately described in the center spread which also contains a numbered outline photograph showing position of important parts.

The center spread also includes information on Cleveland optional extra equipment for special trenching requirements and a table of 48 closely spaced digging wheel and crawler speed combinations available in the Model 110.

Action photographs from all types of trenching jobs demonstrate the all-around useability of the Model 110. Back cover gives complete dimensions and specifications, including a table of optional bucket sizes showing both standard and maximum cutting widths for each option.

## Instrumentation of Sludge Digesters

812

Minneapolis-Honeywell Regulator Company, Philadelphia, Pa., has just issued a revised data sheet on **Instrumentation of Sludge Digesters.**

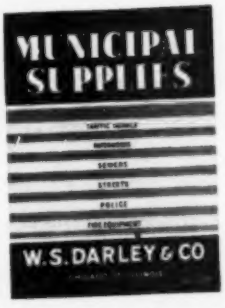
The new data sheet includes additional illustrations and new data based on installations in the most modern sewage treatment plants. It describes automatic methods to measure sludge flow and temperature which are highly accurate and completely free from manual operations.

## Orifice Meters

813

Rockwell Manufacturing Co., Pittsburgh, Pa., has just published a comprehensive 28-page bulletin describing **Rockwell "201" Orifice Meters.**

Featured in the new bulletin are 3½ pages of tables giving representative orifice capacities—offering the measurement man in the field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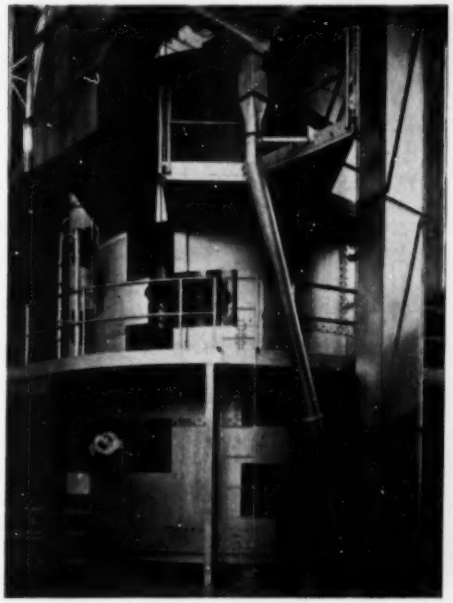
**Nichols Multiple Hearth Dryer-Incinerator design gives the municipality extra dollar value because it reduces treatment time, incinerates raw or digested sludge with equal facility . . . because one unit can be used to dry sludge or to burn it to a sterile ash . . . because plant layout is compact, excluding unsightly drying beds, lagoons, etc.**

***We welcome inquiries from interested municipalities.***

Nichols Multiple Hearth Dryer-Incinerator.



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# MEXICO CITY *Modernizes With* FLEXIBLES!

*Places Largest Order*
**FOR SEWER-CLEANING EQUIPMENT**
*In History!*

Above is a "partial shipment," shown with operators. Modern city administrations everywhere are invited to write for the FACTS ABOUT "FLEXIBLES."

The progressive new present administration of Mexico City was appointed by the President of Mexico on it's pledge to remedy past negligence. One of its first steps was to order more than $297,000 worth of Flexible Sewer-Cleaning equipment to clean and maintain its more than 9,000 miles of sewer, some of which is over 300 years old. Twenty-five freight cars were required to ship the 170 Flexible Bucket Machines, cables, rods, buckets, etc. in this—"the world's largest order of its kind." Flexible equipment was selected after careful and scientific investigation and thorough demonstration!

*Flexible* **SEWER-ROD EQUIPMENT CO.**
**9059 VENICE BOULEVARD, LOS ANGELES 34, CALIF.**
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● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.


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The Pioneer Self Caulking Material for C. I. Pipe

TABLE OF COMPARATIVE QUANTITIES

| Nominal inside dia. in. pipe, in. | Depth of joint, inches of Leadite | Approx. lbs. of Leadite per joint | Depth of joint, inches of lead | Approx. lbs. of lead per joint |
|---|---|---|---|---|
| 4 | 2.5 | 2.00 | 2.25 | 8.56 |
| 6 | 2.5 | 3.00 | 2.25 | 11.71 |
| 8 | 2.5 | 4.00 | 2.25 | 14.63 |
| 10 | 2.5 | 5.00 | 2.25 | 17.70 |
| 12 | 2.5 | 6.00 | 2.25 | 20.86 |
| 14 | 2.5 | 7.00 | 2.25 | 24.02 |
| 16 | 2.5 | 8.25 | 2.25 | 33.07 |
| 18 | 2.5 | 9.25 | 2.25 | 36.88 |
| 20 | 2.5 | 10.50 | 2.25 | 40.71 |
| 24 | 2.5 | 13.00 | 2.50 | 53.02 |
| 30 | 2.75 | 16.00 | 2.50 | 65.36 |
| 36 | 2.75 | 19.00 | 2.50 | 77.96 |
| 48 | 3.50 | 30.00 | 3.00 | 121.15 |
| 54 | 4.0 | 38.00 | 3.00 | 135.60 |
| 60 | 4.0 | 42.00 | 3.00 | 150.70 |

THE LEADITE COMPANY

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No Caulking



# M-SCOPE Pipe Finder

LIGHTWEIGHT MODEL

*One Man Operation*

HIGHLY EFFICIENT

IMMEDIATE SHIPMENT

Catalog No. 25G On Request

JOSEPH G. POLLARD CO., INC.

*Pipe Line Equipment*

New Hyde Park New York


time-saving help in sizing orifice meter plates.

With the aid of full-page front and rear view sectional photographs, the bulletin shows how the "201" meters are constructed and how they operate.

Photo-illustrated descriptions of manifold arrangements and differential ranges available also are given, along with pictures and drawings of various elements of the meters to illustrate specific design features.

A full page of drawings shows how the meters are used with liquid seal chambers and piping for steam, corrosive gases and liquids. Complete specifications are offered for meter mountings and straightening vanes, for orifice flange unions and joints.

Other important featu bulletin include a page instructions for meter ser a page describing meter t operating practice, square and instructions for test ential.

## Scale Drawings of Gearmotors

814

U. S. Electrical Motors Angeles, Calif., has publi drawings of the **U. S. M crogear** line and they are able to lay-out draftsmen, engineers and architects. a simplified style, but to these drawings are design serted under a layout of or other equipment and tr proper size and position. ing many precious man h drawings greatly simplif hance the layout man's w

In order to provide the


# St. Louis Turbidimeter

For measuring turbidity of water. Consists of cast aluminum housing, adjustable lamp . . . two vertical wells for holding two Nessler tubes.



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A. Fill three test tubes with sample to be tested and place them in the base.

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C. Place color slide on base, move across until colors match, and . . . THERE'S THE VALUE!

**Guaranteed Color Standards!**

Sealed-in-plastic color standards carry unconditional guarantee against fading. No single standards to handle. Each slide contains a complete set of standards for any one determination.

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usefulness of these drawings, U. S. Motors has included all the following scales for each motor: 3/32" = 1' (1/32 size), 1/2" = 1' (1/24 size), 3/4" = 1' (1/16 size), 1" = 1' (1/12 size), 1 1/2" = 1' (1/8 size) and 3" = 1' (1/4 size). The drawings are on punched 8 1/2" x 11" paper for easy insertion into any standard 3-ring binder.

Three views are included of each of the 30 various motors shown. Single and double reduction Syncrogears as well as the new worm type Syncrogear have been scaled for tracing. To aid the layout man in selecting the proper motor for the

VY

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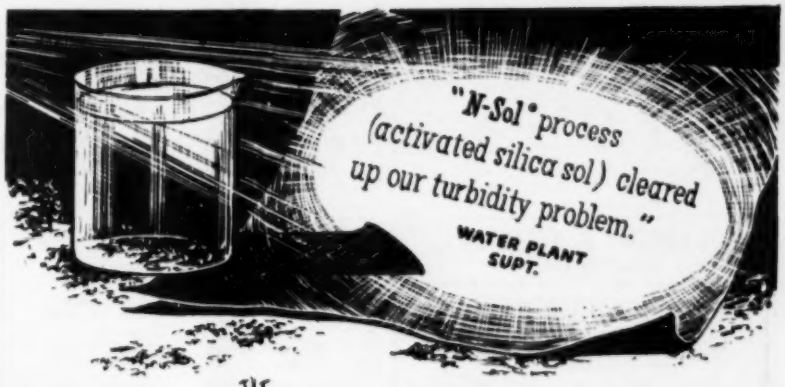
Modes of Control; Water Requirements; Types of Feed; Types of Feeders; Chlorine Discharge Distribution; Chlorine Supply Manifold; and Location of Equipment.


Water, treated by N-Sol Process, sparkles like spring water. This coagulant aid used with alum or ferric salts, produces larger, denser, faster-settling floc than either coagulant alone. Clear effluent results (turbidity often reduced to as low as 1.0 to 0.5 ppm).

Investigate now how an N-Sol Process lowers turbidity. Used widely also for improving color removal.

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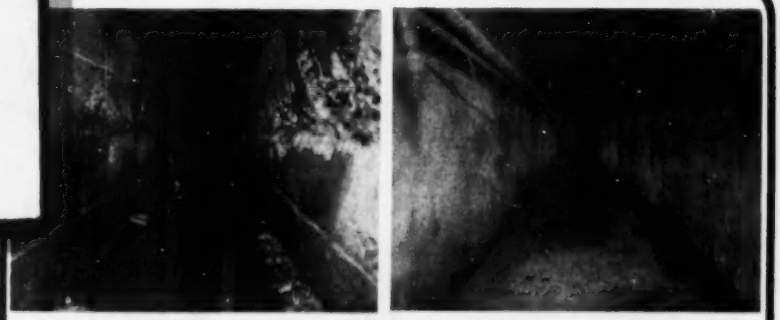

Old Sewer Gets New Life with "GUNITE"

The picture at the left shows an old concrete storm sewer in Washington, D. C., badly disintegrated and honeycombed. Flow value was low due to roughness. This sewer was reconditioned by chipping away the worst areas, sandblasting the entire surface and applying a "GUNITE" lining.

The smooth brush finish increased its capacity sufficiently to meet all requirements, making it unnecessary to build a new sewer. The completed job is shown at the right.

*Many money saving applications of "GUNITE" are described in our illustrated Bulletin C2400. Request on your letterhead will bring you a copy.*

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.
MANUFACTURERS OF THE CEMENT GUN

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LIGHTWEIGHT MODEL

*One Man Operation*

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Other important features of the bulletin include a page of general instructions for meter servicing, and a page describing meter testing and operating practice, square root charts and instructions for testing differential.

## Scale Drawings of Gearmotors

814

U. S. Electrical Motors, Inc., Los Angeles, Calif., has published scale drawings of the **U. S. Motors Syncrogear** line and they are now available to lay-out draftsmen, designers, engineers and architects. Drawn in a simplified style, but to exact scale, these drawings are designed to be inserted under a layout of a machine or other equipment and traced in the proper size and position. While saving many precious man hours, these drawings greatly simplify and enhance the layout man's work.

In order to provide the maximum


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Beginning salary $600 a month. Annual increases are automatic. Applicants must be registered professional engineers. Applications will be accepted until the needs of the service are filled. Write Personnel Division, City Hall, Madison 3, Wis.



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P. O. Box 2V Richmond 5, Va.



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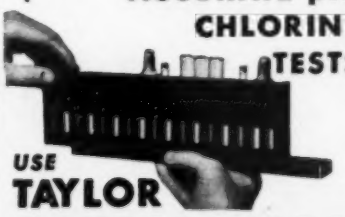

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## Factors in Selecting Chlorine Gas Feeders for Water Chlorination

815

Builders-Providence, Inc., Providence, R. I., has announced the availability of a **Keep Sheet** guide in the selection of Chlorine Gas Feeders. Because of the numerous factors to be considered in selecting a chlorine gas feeder for water chlorination, Builders prepared this guide as an aid for Consulting Engineers, Water Plant superintendents, their own Sales Engineers, etc.

Care in the selection of a chlorine feeder is necessary to assure the desired results, dependable operation, long life, low maintenance and safety.

The keep sheet covers eleven main points to be taken into consideration: Purpose of Water Chlorination; Types of Chlorination; Points of Application; Chlorination Capacity; Modes of Control; Water Requirements; Types of Feed; Types of Feeders; Chlorine Discharge Distribution; Chlorine Supply Manifold; and Location of Equipment.

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Pipe sizes 2" thru 24"

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Water, treated by N-Sol Process, sparkles like spring water. This coagulant aid used with alum or ferric salts, produces larger, denser, faster-settling floc than either coagulant alone. Clear effluent results (turbidity often reduced to as low as 1.0 to 0.5 ppm).

Investigate now how an N-Sol Process lowers turbidity. Used widely also for improving color removal.

**N-Sol® Processes**
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*N-Sol patented processes for preparing activated silica sols from our "N" Silicate of Soda are licensed without royalty.*

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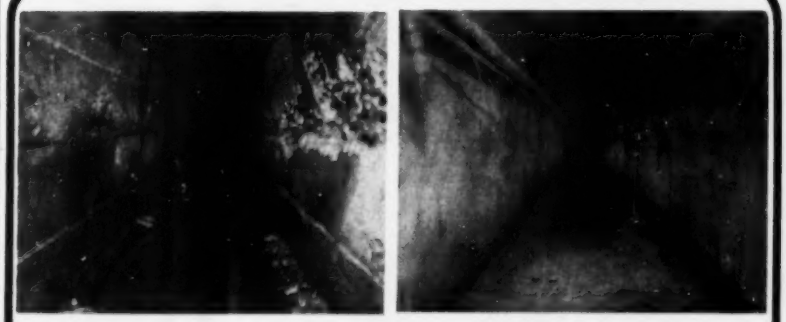

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# INDEX TO ADVERTISERS


**A**

Amercoat Corporation ..... 13A
American Brass Company ..... 93A
American Car & Foundry Co. ..... 32A
*American Cast Iron Pipe Company ..... 31A
American Concrete Pressure Pipe Association ..... 111A
American Water Softener Company, Inc. ..... 102A
*Anthracite Equipment Corp. ..... 108A
Atlas Mineral Products ..... 82A
Aurora Pump Company ..... 76A

**B**

Badger Meter Mfg. Co. ..... 25A
Bucyrus-Erie Company ..... 6A
Buffalo Meter Co. ..... 17A
Builders-Providence, Inc. ..... 80A-87A

**C**

Calgon, Inc. ..... 101A
Carborundum Co. ..... 77A
Carlon Products Corp. ..... 75A
Carson Co., H. Y. ..... 106A
Cast Iron Pipe Research Ass'n. ..... 20A-21A
Cement Gun Company ..... 115A
*Chicago Bridge & Iron Co. ..... 12A
*Chicago Pump Company ..... 73A
Clark Company, H. W. ..... 95A
Clow & Sons, James B. ..... 16A
Crane Company ..... 22A

**D**

Darley & Co., W. S. ..... 112A
Darling Valve & Manufacturing Co. ..... 24A
DeLaval Steam Turbine Co. ..... 79A
Dorr Company ..... Inside Back Cover
Dresser Manufacturing Division ..... 26A

**E**

Eddy Valve Company ..... 16A
Electro Rust-Proofing Corp. (N.J.) ..... 88A

**F**

Fairbanks-Morse & Co. ..... 105A
*Filer & Stowell Co. ..... 104A
Flexible Sewer Rod Equipment Co. ..... 113A
Foxboro Company ..... 92A

**G**

General Electric Co. ..... 14A-15A

**H**

Hamilton-Kent Manufacturing Co. ..... 7A
Hardinge Company, Inc. ..... 110A
Healy-Ruff Company ..... 112A
Hellige, Inc. ..... 78A
Hersey Manufacturing Company ..... 89A
Heresite & Chemical Company ..... 10A
Homestead Valve Manufacturing Company ..... 96A
Hotel Tuller ..... 78A
Hydraulic Development Corp. ..... 106A

**I**

Iowa Valve Mfg. Co. ..... 108A
Irving Subway Grating Co., Inc. ..... 108A

**J**

*Johns-Manville ..... 99A-109A
Johnston Pump Company ..... 103A

**L**

Layne & Bowler, Inc. ..... 83A
Leadite Company ..... 114A
Leopold & Co., F. B. ..... 110A
Le Roi Company ..... 23A
Leupold & Stevens ..... 100A
*Link-Belt Company ..... 97A
Lock Joint Pipe Company ..... Inside Front Cover

**M**

McWane Cast Iron Pipe Co. ..... 115A
*M & H Valve & Fittings Company ..... 86A
Mathieson Chemical Corp. ..... 4A
Minneapolis-Honeywell Reg. Co. ..... 91A
Mueller Company ..... 85A

**N**

National Clay Pipe Mfg., Inc. ..... 3A
Neptune Meter Company ..... 34A
Nichols Engr. Research Corp. ..... 113A

**P**

Pacific Flush Tank Co. ..... 33A
Pacific States Cast Iron Pipe Co. ..... 115A
Payne Dean & Co. ..... 104A
*Philadelphia Quartz Company ..... 115A
Phipps & Bird, Inc. ..... 114A
Pipe Linings, Inc. ..... 32A
Pittsburgh Coke & Chemical Co. ..... 29A
*Pittsburgh-Des Moines Steel Co. ..... 81A
Pollard Co., Joseph G. ..... 114A

**R**

Ranney Method Water Supplies, Inc. ..... 74A
Ridge Tool Company ..... 84A
Roberts Filter Mfg. Co. ..... 112A
Rockwell Co., W. S. ..... 112A
Roots-Connersville Blower Division ..... 94A
*R-S Products Corporation ..... 28A

**S**

*Simplex Valve & Meter Co. ..... 98A
Smith Mfg. Co., A. P. ..... 106A
Smith Co., S. Morgan ..... 30A
Smith-Blair, Inc. ..... 90A
Speelman Elevated Tank Service ..... 104A

**T**

Taylor & Co., W. A. ..... 114A
Tennessee Corporation ..... 76A-110A

**U**

*U. S. Pipe & Foundry Co. ..... 11A

**W**

*Wallace & Tiernan Co., Inc. ..... Back Cover
Westinghouse Electric Corp. ..... 8A-9A
Wood & Co., R. D. ..... 107A
Worthington Corporation ..... 18A-19A

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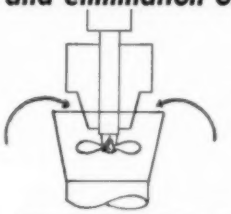

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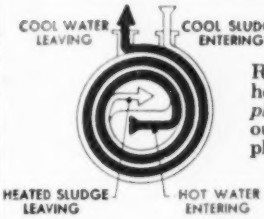


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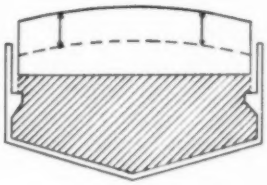

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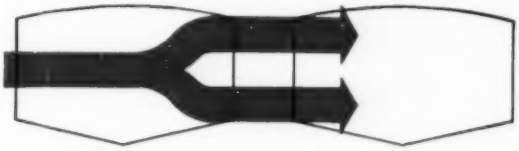

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